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Presentations at the conference, which was attended by 137 persons, included: (1) "A Road to Quality Vocational Facilities" by S.J. Knezevich, (2) "A Systems Approach to School Construction" by John Boice, (3) "The Birth of a New Vocational-Technical Center" by Clayton Farnsworth, (4) "Architectural Features of the Southern Nevada Vocational-Technical Center" by William Blurock, (5) "The Integrated Ceiling" by Harris Sharp, (6) "Teaching and Educational Models" by Al Russell, and (7) "Thermal Environments" by Norman Rutgers. Thirty-one questions asked by conference participants are presented with the answers provided by a panel. (JK)

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PROCEEDINGS

of

National Conference

on

Vocational-Technical Facility Planning

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Las Vegas, Nevada

MAY, 1967

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REPORT OF
NATIONAL VOCATIONAL-TECHNICAL
FACILITY PLANNING CONFERENCE

Prepared by

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and
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University of Nevada
Reno, Nevada

June 1967

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Special recognition is due Dr. Thomas T. Tucker, conference arrangement chairman, and Dr. Robert McQueen, conference evaluator and director of conference report. They performed their tasks superbly.

The conference director appreciatively acknowledges the excellent conference presentations of the following: The Honorable Lieutenant Governor Ed Fike, Dr. Stephen Knezevich, Superintendent Burnell Larson, Mr. John Boice, Mr. Raymond L. Sturm, Mr. Clayton E. Farnsworth, Mr. William E. Blurock, Mr. Norman Rutgers, Mr. Ken Guinn, Mr. Harris Sharp, Mr. Stanley Bokelman, and Dr. James MacConnell.

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- FOREWORD -

In preparing this report the editors took the liberty of condensing some of the more lengthy meetings in the interest of time, economy, and numbers of pages. Great care was exercised, however, to insure that both general themes and specific ideas were presented in a manner essentially unchanged from how they were originally offered to the conferees.

Dr. J. Clark Davis
Conference Director

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GREETINGS

The Honorable Ed Fike
Lieutenant Governor
State of Nevada

The State of Nevada is, indeed, honored to be hosting this national clinic on vocational technical education. On behalf of Governor Laxalt I extend you greetings and every good wish for much success in your deliberations for the next two days.

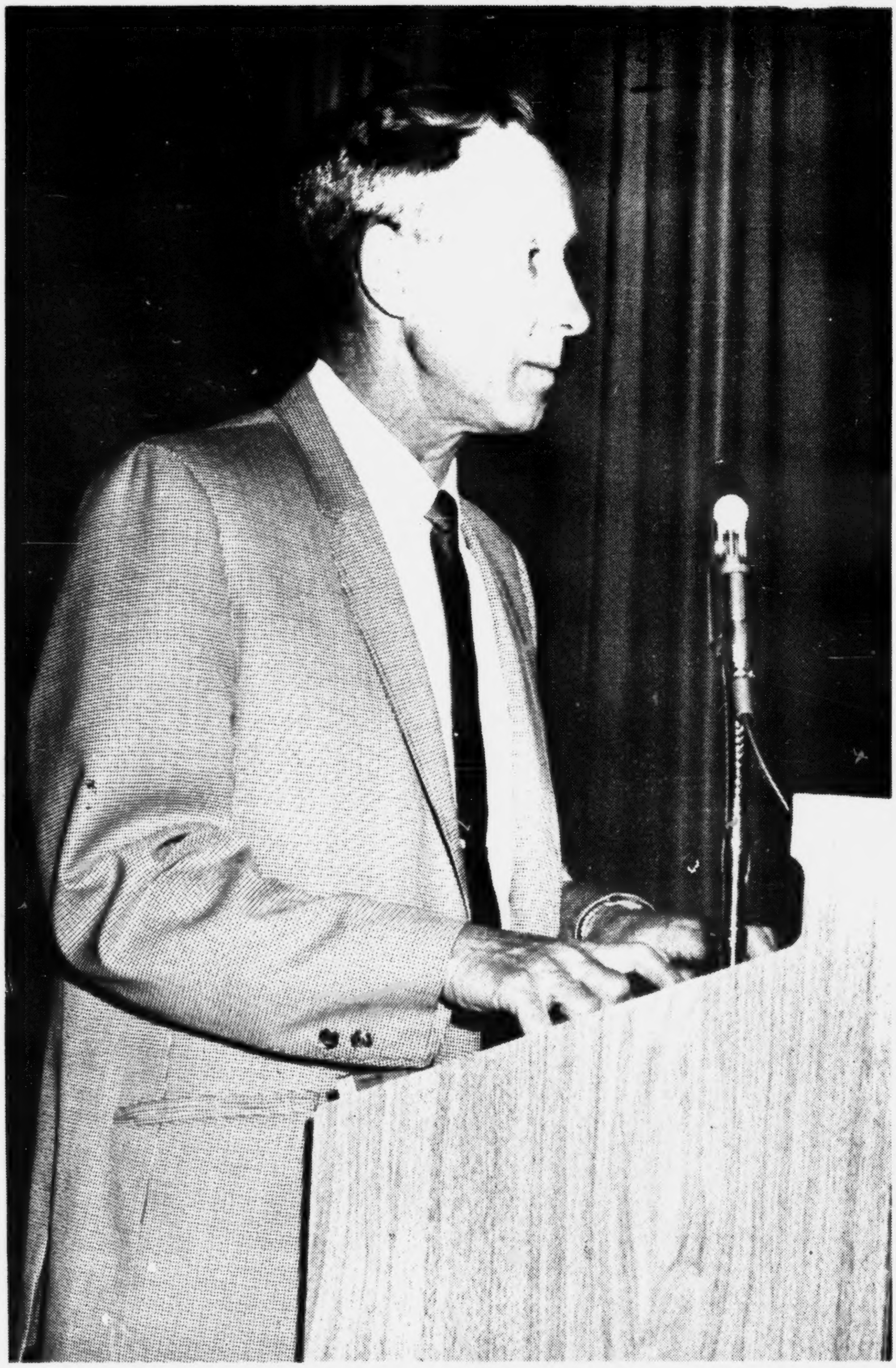
You know, one of the ironies of our time is the fact that we are confronted daily with this great and growing paradox of distressing unemployment on the one hand, and the inability, on the other, to meet the demands of industry for skilled craftsmen and technical workers. There are two basic elements in this picture of unemployment facing us today which have a direct relevance to the importance of vocational education. The first of these elements is that there is virtually no future in this country for the unskilled worker. What has traditionally been his job is more and more going to be done by automated machines. This, of course, is already happening. There was once a place in the old work force for the boys and girls who left high school, either dropping out or with diploma in hand, and who entered the work force directly with no skill or training. He or she could, and often did, take an unskilled job and work up from there. Now, jobs in this category are rapidly vanishing. Every American youngster must today be given, as a part of his education, some know-how which will equip him to earn a livelihood. This means for a great many of them, perhaps as many as two-thirds of the students coming out of our public school system, some type of vocational education.

The second element is the fact that the realization of our potential capacity for economic growth depends upon the entire work force being prepared for the jobs that will be available. While in a broad sense all education contributes to vocational competency, we consider vocational education as that part of a student's instruction intended specifically to fit him for gainful employment. During the present decade the nation's available labor force will be increased by about 12.6 million workers. Though we will have the human resources necessary to achieve a full measure of economic growth, we must be assured that these potential new workers will have the training and skills demanded by our rapidly expanding economy. The need, clearly, is for more vocational education and just as clearly, the need is urgent. There is steadily mounting evidence of the increasing necessity for vocational education facilities, equipment and personnel. Nationally, there are still many programs being carried out in outmoded facilities; buildings that have outlived their usefulness; structures that are frequently ill-equipped and scarcely suited to the needs of a modern and expanding technology. To have successful vocational training programs, there must be new and larger facilities with up-to-date equipment. The facilities and methods used in the training of skilled, technically competent manpower must be constantly adjusted to the changes taking place in today's economy.

State and city governments should undertake comprehensive surveys to determine whether existing training facilities meet the requirements for developing this highly skilled manpower. It is difficult to establish or expand new and different programs until adequate facilities are available. The financial problems of vocational schools are further intensified by the relatively high cost of the required buildings and equipment. To meet these problems area vocational schools have been developed to serve an entire community or an even greater area. Critical in this process is the planning for plant and the necessary equipment. It seems a worthy suggestion, therefore, that consideration be given to the construction of vocational-technical schools in deliberate stages, utilizing a three-to-five year plan, whenever adequate funds are not available to complete construction at one time.

Nationally, vocational education has attained extraordinary prominence. Never before has there been more interest expressed in vocational education than is currently the case. Throughout the nation great strides are being made to develop new vocational facilities and to improve old ones, all to provide our present and coming generations with more effective programs which nurture the skills needed in the world of work. Coincidentally, this calls for wise and forward looking planning in the field of school construction. It is to be hoped that as a result of this convention, and the contribution made by those present today, specific recommendations may be forthcoming which will provide the needed guidelines of assistance to school districts, cities, counties, areas and states in planning for the construction of vocational education and technical training facilities adequate for their needs.

We are particularly proud of our own new area vocational technical training center in Clark County. It is very functional and extremely modern. In it we have adopted a number of innovations which have received favorable comment and approbation from educators throughout the nation. We trust that you will plan to visit our center here during your stay in Las Vegas, and that this facility may demonstrate what can be accomplished by energetic community leaders gifted with vision and guided by wisdom. Again, I wish you much success in your deliberations, and we shall look forward eagerly to your recommendations.



NEVADA SUPERINTENDENT BURNELL LARSON

GREETINGS

Mr. Burnell Larson
State Superintendent of Public Instruction
State of Nevada

Certainly it is a most pleasurable opportunity to welcome you to Nevada on behalf of the State Department of Education and to offer whatever small means we may have of entertaining you and making your stay significant. I'm sure that it's somewhat like bringing coals to Newcastle for me to be involved in this kind of message to you. However, I think that one of the results stemming from an invitation to bring greetings to a gathering such as this is that it requires the one extending the welcome to contemplate the value of a particular conference in the light of the total picture of statewide education.

Facility planning, especially that which provides for vocational and technical education, is of prime importance to all of us. In this day when we must give increasing attention to the non-college student and to the teaching of technical and vocational skills, we must earnestly seek to provide not only an adequate number of facilities, but also to plan for new and increasingly sophisticated programs to fit the needs of a more selective world of work. It is incumbent upon us to make these plans and this requirement becomes more insistent every day. That you here today recognize this necessity is made obvious by the very fact of your presence to study the associated problems. Another of the fine things that I see occurring with these gatherings is the high spirit of cooperation between the established divisions of education working together to accomplish their common goals.

The Small Schools Facility Laboratory of the University of Nevada, the U. S. Office of Education, Nevada State Department of Education, the Clark County School District, and other school districts in the State can only benefit by the cross-pollination which results from planning together to accomplish these important ends. I cannot speak too highly, for example, of the fine cooperation of the University of Nevada which I have experienced during my brief tenure as State Superintendent of Public Instruction. The Research Coordinating Unit, the Small Schools Facility Laboratory, and the Department of School Administration have all been most helpful in providing guidance and leadership. Discussions with the Dean of the College of Education have yielded some new and very promising possibilities in teacher education, all of which have served me most advantageously in my first and possibly somewhat faltering steps as Superintendent.

Let me again express my wholehearted welcome to all of you. Nevada is keenly concerned with education at all levels and in all areas. Our concern with the vocational-technical area is rising rapidly, which immediately casts all of you in the category of special friends. All segments of Nevada's educational establishment will be attentive to the outcome of these proceedings and we will look forward eagerly to your report and recommendations.

STARD
Las Vegas

DR. STEVE KNEZEVICH

KEYNOTE ADDRESS

A ROAD TO QUALITY VOCATIONAL FACILITIES

Dr. S. J. Knezevich
Associate Secretary
American Association of School Administrators

Pride in work and an honest day's labor have been part of a great tradition and remain deeply embedded in the mores of a country whose founding fathers, the Puritans, viewed idle hands as the devil's helpers. Getting a job, earning a living, and being capable of making a useful contribution during a lifetime represent basic yearnings and important parts of the human instinct for workmanship. An occupation is more than a way to earn money. It is an outlet for abilities -- a desire to express one's potential, a way for the teenager to gain entry into the adult world, and a means to achieve some measure of status in American society. The economic deprivation that goes along with joblessness is no less debilitating than its social and psychological consequences. You see the total effect etched on the faces of the jobless unfortunates of all ages. A nation that was to be carved out of a wilderness demanded the productive capacities of its entire population and had little room for an idle aristocracy or a non-contributing landed gentry who depended upon the sweat of another man's brow.

At one time, personal ambition, creative enterprise, and dedicated application -- epitomized as rugged individualism -- were all that were necessary to make one's mark in the world. The forces that shape our lives, that determine to a large extent individual destinies have become more complicated, more varied, and more powerful than ever before. The great technological revolution, generated as a means of promising a better life, on occasion appears to be getting out of hand. Technology has a habit of disrupting previously established and stable patterns of human relationships and work. It renders obsolete old vocational skills and generates demands for new and more complex ones. Many industrial giants of today who employ the nation's manpower are producing products that never existed a generation ago. As a consequence, unique skills, machines and processes completely unknown to accomplished artisans of 25 years ago have emerged. Brute force or muscle power is being displaced by manipulative and cognitive skills with complex instruments of production.

Many have spoken on the theme that technology has changed the world of work as well as the relationship between man and his entry into work, his occupational status, and his productive capacities. Lawrence Lessing in Fortune Magazine of January 1967 examined "Where the Industries of the Seventies Will Come From." He declared that the fuse that touched off the extraordinary technological explosion of the last quarter century was the introduction of nylon about 1940. This first all-synthetic fiber is now part of the $2.4 billion man-made fiber industry. The onrushing technology will reform older industries as well as to create new ones based on fundamentally new fields of activity such as the fantastic laser, superconductivity and superconductive magnets, energy conversion devices, and the new basic structural substances such as Corfam and the related high-performance plastic fibers and other composites. These are the not-too-distant wonders of our age which may generate highly specialized billion dollar industrial complexes which, in turn will demand occupational skills and talent that are out of the ordinary. There is every indication that the dramatic technological revolution of our times will continue unabated. To survive in a fluid climate, more advanced levels of education and more refined skill developments will be required of practically all of the nation's manpower. Educational systems in our society must address themselves to these challenges to enable individuals to cope with what may appear to be unmanageable forces that threaten to crush the lives and spirits of great groups of people.

President Lyndon Baines Johnson[1] in his Manpower Report to Congress in 1964 said:

> We must raise our sights--and strive to realize each person's highest productive and earning capability. We must seek to develop more completely our people's talents and to employ those talents fully--to fulfill the rich promise of technological advance and to enable all to share in its benefits.

Dr. Grant Venn,[2] presently Associate Commissioner of the Bureau of Adult and Vocational Education, echoed similar thoughts when he wrote:

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[1] Johnson, Lyndon Baines. Manpower Report of the President. Transmitted to the Congress, March 1964. Washington, D. C.: Government Printing Office, 1964. p. xi.

[2] Venn, Grant. Man, Education, and Work. Washington, D. C.: American Council on Education, 1964, p. 157.

> *Regardless of his race, intelligence, or place of birth, the human being is the greatest resource any nation can possess. Maximum development of human resources must become a major national objective. The large numbers of youth in schools and colleges represent an opportunity to invest in the only resource which can in the long run bring the* **promise** *of a productive and useful life to everyone. Each time this previous resource is wasted, to whatever degree, it represents a grave loss to the nation and the world.*

As a nation we are committed to the fundamental beliefs that every individual is important and that people represent a nation's most important resource.

The high value placed on human development must inevitably be transferred to those social institutions capable of contributing to the realization of potential that inheres in human resources. Schools emerge during times of ferment as agencies of particular significance. As Grant Venn[3] *put it:*

> *Technology has created a new relationship between man, his education, and his work in which education is placed squarely between man and his work.*

The American Association of School Administrators in a small but powerful volume entitled *__Imperatives in Education__*[4] *concurred in substance with this point of view as evident in the following quotations:*

> *The deep-seated and almost universal desires of people to get along in the world include: food to appease hunger; clothing and shelter for comfort; a home and family; a job that claims the approbation of one's associates; a measure of self-respect,*

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[3] *__Ibid__. p. 1.*

[4] *American Association of School Administrators, __Imperatives in Education__, The Association, Washington, D. C., pp. 20-21, 23.*

> *compatible relationships with other people; and a chance to be somebody of worth, importance and dignity....*
>
> *It is inevitable during a period of change and specialization that job requirements become more complex, calling for a higher level of problem solving ability. The worker who does not keep abreast through training and education soon falls by the wayside. He must anticipate new demands on his talent and prepare for them to avoid becoming expendable. It is imperative that the school be ready to assist him and to lead the way in meeting new manpower needs....*
>
> *It is imperative that dignity be attached to all socially useful labor. One of the first obligations of educators is to raise the prestige of all socially useful labor and to place education for the professions in its proper perspective. At the outside, only 12 in every 100 individuals in the average community will find their occupational futures in medicine, law, teaching, nursing, dietetics, engineering, and other professions. Citizens and parents must come to realize that over 80% of the young people entering the labor market will be needed in occupations other than the professions. While particular prestige has been attached to education for the professions in related occupations, other equally important vocations have been given somewhat lower priority and less attention.*

It can be said that a truly comprehensive liberal education in a free society in this era must include for the large masses of people opportunities for vocational-technical education. The word "liberal" takes its root from a Latin word meaning free. Among the ancient Greeks a liberal education was the sort of an education appropriate for a freeman in contrast to that appropriate for a slave. Keep in mind that a slave during that time was a person who had the misfortune of living in a nation conquered by another and who was enslaved subsequently by his conquerors. The "freeman" of ancient Greece lived on the work of slaves and could pursue an education without regard to its vocational contributions. In this sense, the classical conception of liberal education grew out of economic and social conditions quite different from what we know today. A "freeman" in our society has no slaves and education is not limited to a nonproductive aristocracy. A "freeman" in our nation must depend upon education to gain the skills and understandings necessary to gain and maintain a means of making a livelihood.[5] Man's true destiny in an age of technological revolution is intimately related to use of his abilities and to the availability of educational opportunities to become a productive and contributing member of society. A liberal education, that is, the education of a "freeman", today is incomplete and inappropriate without occupational development opportunities.

Great social challenges are placed at the doorsteps of vocational-technical education today. To produce the creative and effective human being who has the capability of adjusting rapidly and smoothly in a society characterized by rapidly developing technology, and to thereby minimize the social ills of unemployment and poverty, sufficient resources for vocational-technical education become another imperative. Resources are necessary to fulfill a challenge or to translate an idea into ongoing programs and results. A competent staff of teachers and administrators, adequate funds, and functional

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[5] See John S. Brubacher, History of the Problems of Education, New York: McGraw Hill Book Company, pp. 474-484, for a more complete analysis of the rise and development of the concept of "liberal education."

facilities and equipment represent some of these resources. This conference is dedicated to the efficient and effective development of one kind of resource -- the physical facilities necessary for vocational-technical education that will enable schools to contribute to the development of truly comprehensive programs for our time which will enhance the nation's manpower and reduce social ills related to unemployment.

Vocational-technical facilities represent something more than so much brick, stone, glass, steel, or other building materials. They stand as a symbol of the value attached by a nation and its people to a point of view or educational philosophy. The struggle to incorporate and then emphasize vocational aspects of education in the development of children, youths, and adults is reflected in many ways in the design and kind of spaces allocated to vo-tech programs. In many cases, instruction in these fields had to be carried out in basements abandoned by other programs in the so-called hastily thrown-up "temporary buildings" such as war surplus shacks which were ill-suited to important programs assigned responsibility for helping to develop the nation's manpower needs. The inadequate structures indicated the low priority and status granted to vocational-technical education.

A school plant, in large measure, influences what can or cannot be taught. It may help or hinder the instructional capabilities of a teacher. It determines to a significant degree the climate or environment for learning. It can stimulate professional excellence in the teaching staff or force *them to compromise and make-do in cramped quarters or with poorly designed equipment. In large measure, the ambitions, hopes, and aspirations of people for a program of vocational-technical education are expressed in physical and dramatic form in the facilities allocated.*

A basic premise in the planning of facilities is that the conditions that affect education in general will influence the design and utilization of its physical structures as well. In the last analysis, vocational-technical education school plants are the physical interpretation of the types and kinds of educational experiences provided and methods of instruction employed. The design and size of spaces do have a profound influence on the scope and sequence of programs as well as instructional methods and equipment utilization. Trends in all aspects of vocational-technical education must be identified, defined and translated into spatial equivalents and carefully related to each other before facilities can be constructed. Since there are no stock approaches to effective vo-tech experiences today, there can be no stock plans for its educational facilities. Programs today are richer in content, more comprehensive in scope, and more flexible in spirit. These qualities must be exemplified and nurtured in facilities designed for such purposes.

The Vocational Education Act of 1963 represents a tremendous opportunity. Funds were included in the appropriations of this Act for the construction of facilities that can make a difference in helping each individual cope with the technolo-

gical revolution. What is done now will influence vocational-technical education for at least the remainder of this century.

To translate newly allocated funds for construction into effective and efficient edifices capable of projecting the significance and importance of vocational-technical education in our society is the fundamental challenge of this Conference. As was stated in Imperatives in Education:[6]

> Modern up-to-date housing for vocational education can improve the image of the man who works with his hands.

This is a golden opportunity and at stake is the future of quality instruction and comprehensive experiences for vo-tech as well as its future image in our nation.

Perhaps the first step on the road to quality facilities is to overcome the "basement psychology" that grips those who have lived too long and have had to compromise too often with inadequate buildings. Prolonged deprivation can stultify the imagination. The Vocational Education Act of 1963 creates a new environment and should stimulate vocational educators to fashion an ideal setting.

It may well be that we cannot catch up on all that is needed within the funds appropriated in one act. School house construction was considered a rare event, that is, a once in a lifetime occurrence until the great expansion following World War II. This led many to strive to build all school facilities in a brief period feeling "it is now or never." This is in stark contrast with the construction patterns for cathedrals erected during the middle ages. They were conceived in terms of centuries of work. The Washington National Cathedral is being built on a plan that approximates the ancient pattern with completion contemplated over the span of many decades rather than through a one-shot limited approach. Perhaps the time has come to shed the notion that a complex school reaches a state of finality at a certain point usually within two or three years. I shall use the term "cathedral approach" as signifying an extended period of time for planning, constructing, and improving upon educational facilities. "Extended period of time" is defined further as no less than 10 years.

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[6] Op. Cit. p. 24.

The shift toward the "cathedral approach" to construction demands may be one way to avoid making crippling compromises. It is better to award limited funds to high priority. spaces constructed to meet highest specifications and to defer that which can be delayed until additional fiscal resources can be procured. Rather than compromising all spaces to less than adequate specifications it might be appropriate in many cases to consider vocational-technical schools in terms of phases with specific parts scheduled for construction over relatively long periods of time. Another very important part of this concept is that a truly dynamic vocational-technical program will require modifications and expansions in the years following initial construction. Devoting a generation to plan, design, and construct the many features required for a truly dynamic vocational-technical complex is relatively short *compared with the "cathedral approach" to construction of religious facilities.*

In the last analysis the true measure of quality in any facility is how well it satisfies present and future goals of vo-tech programs. Changes in society's demands for vocational skills over a generation or more have been expressed in many ways. During a lifetime the average person may have shifted to five different kinds of jobs. It is not unusual for those presently employed in one occupation to return to school to learn another specialty. The shifting occupational demands precipitated in part by the emergence of new skill occupation suggest that it is well to design facilities for vocational-technical education that can be modified with ease through expansion or alteration. This is one way spatial allocations can reflect the dynamic spirit that inheres in this field. Flexibility in design is an important must in all quality construction. Stated another way, it is essential to plan, design, and construct facilities for performance rather than permanence. The educational specifications which communicate to the architect the educational functions to be performed within a facility should emphasize the changing of spaces to keep step with emerging demands upon vocational-technical education. This in turn points to the necessity of space configurations that are based on modular units for services as well as placement of partitions.

Quality facilities recognize a student as a human being with personal and social dimensions as well as educational needs. The aesthetic environment can help him develop a sense of pride in his affiliation with the program or it can result in more frustration to battle while pursuing learning tasks. A comprehensive school plant incorporates recreational and social areas as well as those dedicated to the specialized vocational motivations of students. Even such mundane things as a parking place well located with relation to the building and easy access to and from site should not be overlooked in planning.

It is beyond the scope of this paper to outline in detail the complexity, variety, and specialization of functions and their interpretation into spatial equivalents for vocational-technical education. Suffice it to say at this point, extended periods of planning are required before a single line is drawn to represent an emerging blueprint. The issues of how laboratories and classrooms are to be clustered, interrelationships of learning units, traffic flow, multiple use of spaces, and what parts of the plant will be used mainly during the day and what part during the evening must be specified. The many roles of the teacher as an instructor in a laboratory, as a discussion leader in a more formal classroom, as a counselor in an office, and as a professional person who required a place to plan, to study, and to research deserves careful consideration if quality is to emerge in the facility. The teacher planning and instructional spaces, when coupled with unusual instructional equipment and procedures, make the vocational-technical plant perhaps one of the most complex and difficult educational facilities to plan.

Technology is affecting not only the world of work but the world of teaching as well. It is imperative, therefore, that spaces designed be compatible with newer instructional technologies. There can be no quality without a recognition of a likelihood of computer-assisted instruction, educational television, and a variety of new approaches developing in education. Attempting to cut corners or failing to provide for easy expansion in service loads, such as, electrical, water, heating, air-conditioning, or plumbing service requirements would be penny-wise and pound foolish.

Many have declared that continued employment today means continuing education. Vocational-technical facilities will be utilized by students of all ages and many will have very special occupational needs as well. There will be students during the day and others will attend during evening hours. It follows that vo-tech facilities are more likely to approximate 'round the clock and year 'round use than any others. It becomes imperative, therefore, that appropriate materials be selected and effective designs be implemented which would make the plant easy to clean and maintain. Ease of operation and maintenance in facilities to be used extensively during the day and the year become marks of quality. Economy of construction cannot be determined solely by low first or initial cost of a plant. It is poor economy indeed to employ shabby materials in an effort to reduce initial cost at the expense of subsequent sizable expenditures annually for operations and maintenance. It cannot be emphasized too strongly *that ease of maintenance and operation must be built into facilities by selecting the appropriate materials and design.*

No building is likely to be perfect but it is most unfortunate and unnecessary to keep repeating the same mistakes in design and construction time after time. Your mistakes should be original and reflect a willingness to probe for better designs of learning spaces, better plans for aesthetically pleasing climates, better utilization of more effective construction systems and better development of more functional environmental systems. There is an urgent need for a new breed of facilities that can more adequately meet present and future challenges. The school cornerstone being laid today marks a significant event. Construction programs upon which you may be about to embark can be an exciting adventure to produce the kinds of physical resources for vocational-technical education that are pleasurable to the senses, that exalt the mind, and that can quicken the development of necessary manpower skills.

A SYSTEMS APPROACH TO SCHOOL CONSTRUCTION

Mr. John Boice, Project Coordinator
School Construction Systems Development
School Plant Planning Lab, Stanford University
Stanford, California

"To say that things are fast changing in vocational education is not quite true. The pressure for change is enormous, change is in the air, change is being effected to some degree in some school districts, but this is basically a revolution in the making, it has not as yet arrived. When it does, though, the lightning speed and intensity of change will more than atone for its slow start." This is a quotation from a recent article on vocational education in School Management Magazine, titled "Vocational Education -- A Time to Shift Gears." I think most people would agree with at least part of that statement. There certainly is a pressure for change. But there seems to be a lot less agreement on the direction that that change ought to take. Since I'm not an expert in the vocational technical field, I suppose I am free to offer solutions to some of the problems relative to the task of designing facilities in which to house these new programs.

For some years I have been engaged in trying to interpret what people said their program was in order to get it translated into a form that the architect could understand. It's exceedingly difficult to build and create spaces for programs when we don't know the exact nature of these programs. One of the things that school administrators, planners, and architects like to do when confronted with this problem is to hop into an airplane and look at what everybody else has been doing. And we, of course, are going to do some of that very thing this week ourselves. Educational Facilities Laboratory, with whom I am associated, has spent a lot of time and money sending people around the country to look at what other people are doing to solve their own particular problems. We have a regular road show that comes through our planning laboratory at Stanford University -- hundreds of people every month, all looking to see how someone else has solved the problem of facilities for programs. Primarily they are interested in finding solutions to facility problems. I think this proves to be a very valuable experience. I do think, however, that these tours will be helpful only if the demonstration facilities are related in some meaningful manner to the programs that they are designed to show. The building, no matter how esthetically pleasing or technically perfect, exists for only one purpose, and that is to facilitate some educational program. Unfortunately, very few awards are based on this premise. The national design awards and the magazine awards, and all the other awards usually are graded on some criterion of attractiveness, rather than on how functionally suitable the building is for the program it houses.

If we really believe that the building spaces should reflect the program, it seems to me that one of our more important tasks is to interpret this correctly and concisely so that it can be put directly into the bricks, mortar and stone. All of this, of course, has been said before. The real problem is how do you go about translating this when you don't know what the program is -- when you can't see clearly the direction, the scope, or the magnitude of the program under development. If we had a final answer to the program and that answer would remain unchanged for the life of the building, say for fifty years, then we would certainly be a long way toward solving our facility problems. We would describe the program, devise our spaces to fit that program, cast it in stone, and be confident that we would have a building that would serve us well during its 50 year lifetime. But the situation in which you and I find ourselves is quite the opposite of that. While there may be a few who can detail the program they now have, there are still fewer who can forecast what it is that they intend to do in the future, and fewer yet who can see a clear direction that we ought to be taking in this field. Will we have a building that is really functionally geared to the program requirements for one, five or ten or 15 years? Just how long will this building we are thinking about and planning for now really be useful?

The program requirements given to the architect three years in advance of the time when the building is first to be used may not even have relevance for the proposed program that will be housed in the building on the day it opens. What can and should be done, then, to provide for this expected change in program and, consequently, in the space changes required to house these programs? What is clearly needed are spaces that can quickly and inexpensively be adapted to changes in program and teaching methodologies. The key ideas, of course, are the need for flexibility achieved at reasonable cost.

The first question I always field after describing some of the things that we have been doing in the systems field is, "How much did it cost?" or, "Is it more expensive than conventional construction?" Yet the real question is not, how much did it cost to build, but rather, how much value did you receive for what you spent? Generally speaking, we have found that there is nothing more expensive than a cheap building.

One of the measures of value that should receive more study is the one based on the concept of the useful life of the building. To illustrate, let's look again at our building that we built to house a program which was to continue for the 50 year life of the building. If that building had cost $5 million to construct and it had its planned useful life, that building would only have cost us about $100,000 a year -- very inexpensive. If, on the other hand, that building's life was only 10 years and at the end of those 10 years extensive and expensive remodeling was required to bring it into line with the things we wanted to do then, the difference in per year cost of the building suddenly becomes very apparent.

Some of these kinds of considerations were considered recently at a conference in St. Paul, Minnesota at which the North Star Research Institute commissioned one of the local architectural firms, Zellerby and Company, to take a look at just what this meant in terms of a very simple structure, a small classroom building. The results were startling and, without burdening you with many figures, underscored the point that the long-term return on facility investments is far more critical than are their initial costs.

Are there any answers, then, to the cost/quality flexibility problem? Let's examine for a moment two major problems in this area. First of all, one of the most obvious reasons for the increase in the cost of buildings is the high cost of on-site labor, up 38 percent in the last eight years and showing no sign of leveling off. The second major factor is in the inherent inefficiency of our building technology. We seem still to be in the handicraft stage when it comes to building construction. In an effort to reduce the amount of on-site labor, we have turned to the traditional American way of cutting cost, that is by industrialization. This means we produce in our factories larger and larger building components and have them shipped directly to the site ready for rapid installation. This method takes advantage of the generally lower factory wages and the generally higher measure of quality control that is available in most plants. Such attempts to industrialize the building process are not without their own special problems: social, political and technical. There are, however, some signs of progress even within these complicated areas. One thing is clear, though, the handicraft approach to building schools simply will not be appropriate in the years ahead.

The on-site labor problem is closely related to the second major obstacle to be overcome. That is finding ways to improve our building technology. One of the major efforts in this regard is what is known as the "systems approach" which is sometimes confused with a lot of different things. We have systems for car washes, systems for research, and systems for aiming and directing very complex guided missiles.

In discussing building systems, I think a distinction should be made between the building system itself, and the process by which a building comes into being. In a sense one can regard any building as being built with a system, or a set of sub-systems. However, the way in which a conventional building comes into being is often far from systematic. Much of our interest focuses on the discrepancies between the systems of the building and the way in which they are designed, as well as the way in which they are built.

With the advent of larger and larger components and more and more factory work, the architect is spending greater portions of his time trying to fit together these larger elements as they are delivered to his job site. An example might help to clarify our concept of building systems. There is an analogy between a well-designed and familiar system, the human body, and the building systems as we know them today. It is common in medical training to separate the study of the human body into various functional systems. The body has complete systems which perform entire functions. Take, for example, the muscle system or the skeleton system. These two familiar systems perform functions closely analogous to those found in the building industry. It's significant also that these systems have little meaning as independent human components. They perform no meaningful function unless they are operating together and in harmony with the rest of the organism. If any of these systems becomes displaced or malfunctional, we are at once disturbed because we know there is something wrong with the total system of the living body. Likewise, should a portion of the skeletal system become visible, we know that serious injury has occurred. Another analogous point is that all systems grow concurrently with the overall growth of the body. The parallels between the human body and a healthy building are, indeed, numerous.

One additional element should be mentioned. So far we've only talked about the functional aspects of body and building. It might be well now to think for a minute about some esthetic considerations. While the skeletal system may be a thing of beauty to a student of anatomy, to most of us it has different connotations. Esthetics, while typically independent of function, should not be despised either in human bodies or school buildings.

Recently, we visited the Lockheed Aircraft Factory in Marietta, Georgia and watched the way they put some of those giant planes together. And, of course, they get parts and systems that are designed in every quarter of the United States, bring them there and fit them together. If they were to operate on the same kind of principles that we operate with in constructing buildings, I'm sure that they would have a peculiar looking aircraft by the time they finished, and one, incidentally, which would not be very airworthy. Certainly consideration has to be given to all of the elements that go into the structure: what space each will occupy, and how will it relate to the other pieces so that we finish with a functionally efficient system. While a building admittedly represents a lower form of design than an airplane, there is, nevertheless, a tendency for the modern building to become more and more complex. In place of a simple masonry shell to which a few heating pipes will be added and a few lighting fixtures installed, we see now a complex arrangement of ductwork, lighting conduit, air conditioning systems, piping, television conduit, and a great variety of elaborate electrical systems, all of which have to be closely integrated into the final building. The traditional process of school construction is fast becoming antiquated in the light of the great multiplicity of technological requirements set for modern educational facilities.

One of the major problems arises because the building is made up partly of components manufactured in distant factories and partly of materials both fabricated and fitted together on the job site. The factory-made components are designed with little relationship to each other, requiring much of the architect's time to arrange for their concerted functioning. If one returns to the analogy of the human body, the building scarcely comes together in a way similar to that of the human body. If one had set out to design the human *body, farming its components out to various sub-contractors with one making the hand and another the arm, and still others the remaining parts, one can see that without very close coordination between all of the contractors we would have an exceedingly difficult task in getting anything that would function properly. Yet quite often this is the very way we set about constructing our buildings.*

We take all of these separate pieces, which were designed without any particular relationship to one another, and then hope in a short period of time that we can succeed in getting all of them to relate properly to one another. The systems building very deliberately attempts to recognize this basic problem of building design and to relate processes of production and construction to this design approach. If we take a look at the systematic process of building construction, we find it existing in varying degrees, all the way from a very simple expression, perhaps through volume bidding, to a complete system with numerous ranges in between. Of course, most of our ***buildings*** *are evolving out of one or another of these partial systems.*

We are participating in a project in Pittsburgh, Pennsylvania in which the people there are going to build five large high schools, for five thousand students each, within a very short period of time. They plan to consolidate all their high school students within a very large and complex program. They have turned to a systems approach as a means of assuring quality control for this massive undertaking.

In establishing this process we are separating the functional systems of the building into appropriate categories. This is what we did when we worked with the S.C.S.D. Project. The project directors decided on the categories that they thought were the most appropriate for us to tackle at a particular time. Everybody would have liked, for example, to work with the plumbing as it related to the building. But after doing some investigation, we came to the conclusion that unless we wanted to devote all our energy just to plumbing we would not get very far. What we finally did was to decide on a structural system to embrace all support problems of the building, including air conditioning, lighting and interior partitioning as the first of our components. It's possible to get these systems designed by those involved at the factory level in such a way that they will relate to one another efficiently when they come together in the building. Thus, the structure is designed from the very outset to recognize the needs of air conditioning ductwork and space for electrical conduit. As a result, when these systems come together on the building site, most of the problems of spacing and fitting have already been solved at the point of design or production. I'm sure you'll all agree that it's a good deal easier to move a water main around on a drawing board than it is after it is covered with six inches of concrete!

Production for volume, besides enabling better functional efficiency, can also result in some substantial cost rewards. As the cost of labor increases, and as the complexity of buildings increases, we can see the need for more and more rationality in the design and construction process. Systems building is an attempt to introduce this rationality into the building process at an early stage. By now we have gained enough experience with it to show that the gains in economy and in function can be significant.

For systems building to be effective three conditions are necessary. First, there needs to be a large volume of building so that appropriate industries may be involved in components on something approaching a mass production basis. Secondly, there needs to be sufficient preliminary time to enable industry to get to work in an effective way to produce properly tailored components. Usually the large project brings with it the time necessary for industry to do its work. Thirdly, the project should have clearly defined functional goals upon which it is possible to reach a consensus for what is required. Knowing the educational requirements makes it possible for specifications or standards to be written enabling industry to take proper advantage of the large volume of work. Clearly, there is no economic value in a large volume of work if all the components must be different. A good example of how this works out in practice can be seen in the auto industry where there are a large number of unit options, but where all are based upon a small number of parts which are rationally designed to fit quickly together.

Brunell, 120 years ago, designed a wooden hospital in

England, shipped it from there in transportable pieces to the Crimea and assembled it near the battlefield. This hospital was big enough for 200 beds, and that, I would remind you, was fully 125 years ago! Legend has it that this was the beginning of the concept of component design. At the very least it was a prime example of the logical use of building components made to fit together easily and quickly, and to overcome a particular set of circumstances. Another example occurring 125 years later is the School Construction Systems Development project which has been used in portions of the Southern Nevada Vocational Technical Center. We made a movie which we designed to use with contractors and people who were interested in the systems concept. This is not a finished movie, but it is a unique one. It consists, in part, of a time-lapse photography sequence of the construction of the mock-up building used to test all of the pieces that went into this system. We mounted a camera on a telephone pole behind the job site that took a frame every 75 seconds all through the exterior construction phase and then put all these together to show how the building unfolded, much like you do in showing children through time-lapse photographs how a flower blossoms. The movie gives a graphic explanation of the systems approach and shows better than we can relate the organized flow of work which is its initial aim.

In summary, it might be wise to add that the use of the systems approach to design and construction of vocational technical facilities is not going to solve all the problems of providing a dynamic program geared to the needs of a space age society. What this method can do is to help provide a facility to house such programs effectively and efficiently, and over a longer period of time than any other approach that I know of at this time. It happens that a great many of the needs for flexibility, better value for the building dollar, and efficiency in construction are objectives that are equally applicable to most types of building. Certainly there is a need to study the construction process further. We need especially to look at our requirements in terms of our own programs to see whether or not what we are doing is appropriate for our own type of program.

In the last analysis, it is important that we get good value for the money we spend, stretching that dollar value over a long and useful period of time. A systems approach to construction is much like purchasing blue chip stocks: it not only gives you immediate return on your investment, but over the years assures you of sizable annual dividends.

THE BIRTH OF A NEW VOCATIONAL-TECHNICAL CENTER

Mr. Clayton Farnsworth, Principal
Southern Nevada Vocational-Technical Center
Las Vegas, Nevada

While generally in education it's not often the case that people who are going to open a new school have the privilege of being placed on the job well in advance of the opening date, I was assigned as principal a year and a half prior to the arrival of any students. This, I think, was good for the school and certainly was good for me. Total planning involved putting the center into general operation. We were working against a deadline to finalize the building plans.

My first responsibility, therefore, was in working with the architect to bring this about. From the very inception of the idea, there had been a close working relationship with the people of the community, the school system and the architect, as well as the staff of the State Department of Education. I resolved to do all I could to maintain this type of relationship with the people by forming advisory committees. In the process, 16 advisory committees of important people were created representing management and labor drawn from areas to be reflected in the training programs that we would be teaching at the vocational technical center. These people were encouraged to suggest ideas that we could incorporate into the total plans both architecturally and educationally.

The facility, as it now stands, represents an expenditure of approximately 3 million dollars. We were bound by this amount so that when advisory committee members made some rather elaborate suggestions, it was necessary to point out this limitation. Consequently, while we accepted many of the recommendations that these people made, it was also necessary to turn down some of them. However, the facility will eventually include many of the committee's ideas in one of its later construction phases. While wanting to work with these advisory committees, we were also interested in bringing in as many suggestions from instructors as possible, even though all instructors had not been selected. We also talked to many of the people who were currently employed in the school district in positions of vocational-technical education.

Upon entering the facility one sees only two areas that are now permanently located. This is so because of the flexibility built into the structure as part of the total master plan. Both the Auto Body and the Auto Mechanics area will remain as they are now situated in the final phases. The Culinary Arts area, likewise, will remain as a permanent component. All of the rest of the areas in the present facility will ultimately be located in different settings as called for in the master plan.

We have on our campus about 390 acres. This was an expensive piece of land. If you were to price some of it you would find that even sage brush land sells for from $3,000 to $5,000 an acre. Luckily, however, as the school facility people were making advance planning for the location of various schools, they happened to learn that this was Federal land, and so instead of paying $3,000 to $5,000 an acre, this land wound up costing us $2.50 an acre. It proved to be quite a savings to us.

By 1985 we'll have three quarters of a million people in Clark County, or about three times the population that we now have. This area, desolate as it may seem to be now, will have 200,000 people located around it in less than 20 years. We were looking ahead not only from the perspective of facility planning, but also 15 years in the future with its attendant population growth. For these reasons and many others we thought it essential that the school board engage someone to put into operation many of the details that have been worked out at the Center. Without such an on-site coordinator many of the things that we wanted incorporated into the building would not be there when it opened or even later in the future.

We employed a type of planning that is carried on primarily in industry, the PERT planning or the critical path method, and we felt that it was important to establish a definite direction of planning. Most educational facilities are put into operation in a haphazard manner, with the individuals who are chosen to operate the school being chosen just a month or two before the school actually goes into operation. We sought to eliminate much of the guesswork that previously had gone into the opening of new schools. Responsibility areas were determined with each of the various departments of our school district. For example, we were *concerned with the personnel department, the curriculum department, with student selection, with public information, and with purchasing. So we went to each of these departments and established with them a flow sheet on which we determined who was going to be responsible for specific planning in bringing this facility into operation. We established with them an understanding of what their job would be and from this we drew up a PERT plan indicating responsibility areas for everybody in the departments involved. Afterwards we asked each department to develop its own network and its PERT plans of operation so that they could bring all planning together. Opening a new facility puts a tremendous strain on the personnel in the administration and this farming out of responsibility tends to ease the strain. The facility still has areas that we have not yet put into operation. Some planned programs, most notably the Air Frame and Power Plant sections, we were unable to start because equipment was not available.*

One indication of the value of flexibility is in our Automotive display section. Very abruptly we received a directive from the Superintendent that our Educational TV would henceforth be located at the Vocational Technical Center. With very little effort we are now in the process of putting in the module walls which will complete the transformation of that section of the facility into Clark County's newest TV center. The type of planning that has gone into this facility permits us, as we find programs that are not of value, to move them out, replacing them with more suitable ones.

We have also been working quite successfully with the Manpower program. We found that Manpower had a lot of available equipment. We were able to move some of the Manpower equipment into our facility in exchange for the use of our educational plant. We now have about $250,000 to $300,000 worth of equipment that belongs to the Manpower program that's being used by those people on a part-time basis. We, on the other hand, use it during times when it would otherwise be idle.

In our facility right now, though we only opened this academic year, we're starting some classes at 7 o'clock in the morning, with others that are ending at 11 o'clock at night. There are approximately 350 high school students in our program. Pooling the Manpower groups with post-high school students, we have had about 650 adults during our first year of operation. Altogether, our facility has touched over 1,000 people. Next year we will boost enrollment to approximately 700 or 800 high school students, with an equal number of adults. Later, when we go into the second phase of our operation we plan to accommodate approximately 1500 students; and as we expand into additional phases of the program, we are thinking in terms of 5,000 high school students and approximately 7,000 adults. Some of these, of course, will be part-time students, but many will be full-time people embarked on two-year training programs.

One aspect of initiating a vocational-technical center involved public relations. We felt that we had to establish a proper image to place before the people of our community. Part of this was achieved through a vocational-technical conference. Yet many adults were initially opposed to the thought that their son would take training which ultimately would result in him carrying a lunch pail to work. We realized that we had to dignify the world of work as far as vocational-technical education was concerned, and this was attempted through an extensive public relations program. We also felt that such public relations for the Southern Nevada Vocational-Technical Center should be continuous; that there must be a constant flow of well-prepared information reaching the public. Nor should it be a one man operation, but rather a cooperative effort of the teachers, administrators, counselors and all personnel concerned with vocational technical education.

To do all this effectively it was essential to have full cooperation from the established public relations program of the entire school district. We set out to acquaint the people with what we were attempting to do. One very encouraging thing about this was that as we went into the schools and started to talk to some of these people we found real enthusiasm from the students. While the students saw the need for this type of training, when they went home they were confronted with the attitude that vocational education is a second rate type of education. This is a stance that any of you who are not already in this type of program are going to encounter somewhere in your community. When we finally got the school open, with students attending classes, and tours coming through, then the people, both young and old alike, began to say, "Well, golly, we don't have to go to college to have a fine educational facility. Nor do we have to go to college in order to experience people treating us as adults and giving us an opportunity." One boy said he thought the Southern Nevada Vocational-Technical Center was an old warehouse that had been taken over and was being used for vocational training. This, unfortunately, is the type of picture that most people have of vocational education. This is why we continue to be concerned with building public relations. I suppose that the best public relations we're going to have is when these young people go out on the job. We welcome that prospect because they are genuinely proud of their school. I say to these young people, "I'm not giving any teacher supervisory duty in this school. Every one of you has the responsibility of your own discipline. If you can't behave and conduct yourself as a young man or a young woman, we'll ask you to leave because we don't feel we can recommend you for the world of work."

We feel that we've established a fine image this first year even with a small group of students. As we bring more people into the program, we are confident that we can continue to dignify the image of vocational-technical education to the point where we can make it important not only to our community, but to the young people who are going to be a part of it.

ARCHITECTURAL FEATURES OF THE SOUTHERN NEVADA VOCATIONAL-TECHNICAL CENTER

Mr. William Blurock
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The Southern Nevada Vocational-Technical Center rests on an exceedingly interesting site. Because it was government land, it was not in the high price bracket, and as a consequence there were some service and utility problems which, along with many others, had to be resolved. Many times an architect will get a nice wooded site, or a rolling one or a flat site. But here we had a truly virgin piece of ground. It stands high on a mesa about 100 feet off the valley floor, with no real problems except getting utilities to it and drainage from it. It originally amounted to 160 acres. Survey showed it to be flat to within one foot on the top.

There were other problems directly related to the nature of the site. For example, the wind could be blowing moderately in downtown Las Vegas, but fiercely out on the site. If it was 100 degrees in the city, it would be 120 degrees out there. On the other hand, if the temperature is down to 25 or 30 degrees in Las Vegas, it's probably another ten degrees colder on the site. So we found ourselves taking some unconventional approaches in solving many of these problems. But the unique and the different bring a kind of contagious excitement and enthusiasm to the project.

The master plan called for around 600,000 square feet of building space. The first phase resulted in only about

200,000 square feet of usable space and we are just now entering the second phase which will be a bit smaller. Yet, in talking about a facility of this kind on a site with the weather conditions referred to above, we felt we had to take a different stance in developing the outside spaces as they are related to the inside ones.

As architects, we're one member of a large team. The educational consultants, the staff, the superintendent, the board, all form parts of this team and we all tried to work as closely together as possible. We agreed at the outset to appraise each other of the problems that each was encountering so that cooperatively we could solve them one at a time. The Student Center proved to be a very interesting illustration of this team approach because we were trying to take a different tack here. Typically, when vocational-technical facilities are combined with another type of facility, the academic requirements always take the front row: they're up by the library, they're out where everybody can see them; they're clean and pretty. On the other hand, the shops and the automotive area, and the air frame center are out in the back forty somewhere. We wanted to break this practice and bring those areas to the forefront. To do this everything was to be placed around the student center, making a free area for study, for eating, and for ready access to the various vocational-technical components. This was the theory with which we started very early. We resolved not to go outside to anything. As part and parcel of this attitude we also tried to eliminate corridors. We have a few, of course, but very few and there has been no weeping for those absent hallways.

As you know, many of our new shopping centers are being developed in a manner that has a central mall. This is the type of structure we contemplated. The central mall is the structural center, where offices can be located and where various other functions can take place. It may be used as a lobby or an entrance to the instructional areas that form around it.

In turning to some thoughts on cost, I don't want to confuse the word economy with basic cost. I don't think the building was any less expensive because we used a special system, but we did get better use out of spaces because we can move any wall at any time with no more than maintenance personnel.

In a facility such as this one there should be places where students can go on a break and get a coke or maybe a quick snack. There should be places for faculty offices where instructors can have their work spaces and be apart from the students at times. There should also be an area where there are displays for the various disciplines and groupings.

We wanted to get rid of the common shops and replace them with instructional areas. We proposed an automobile agency approach to this program. Such an area can be for student classes, for displays, where students assemble an automobile, or repair it, or otherwise put it in good condition. There can even be an automobile showroom in the lobby of the automotive area. One portion of it would be what one might call the automotive lab, and this is a clean area where clean equipment is used. The auto paint shop would be in a similar category. No one would ever confuse these areas with an old-time auto shop. These spaces open directly into the lobby. They're acoustically treated with carpeting throughout. If the instructor wants students to go to a central point, they can go right into the lobby by walking the shortest possible distance. There is no passing through many doors, hallways or corridors.

The student center area was conceived so that the library and its carrels, adjacent open spaces, classrooms around on the upper floor, and the faculty dining area would all be together. The upper balcony houses the culinary arts program and it permits students to prepare the food as well as to serve it, both in the interest of instruction. All the facets of the food program, from gourmet to snack shop, to serving, to dishwashing can be taught there.

Returning to the first phase of the program, because of money limitations, increment programming and all the other things that go with architecture and school production, available funds did not quite cover all of what we would like to do. So the first phase program was stretched permitting the student center to be completed. The library is being planned now, the automotive-technical area and air frame area is to be connected by a covered walkway, which will be part of the second phase.

The materials resource center again is an extension of the open space concept. It is divided by levels so that you can see the materials but can't reach them except through a central desk control. While the area is controlled, it retains a feeling of informality. Within the material resource center is the audio-visual section which will also be a control center where students can come in and obtain materials that are passed over a counter. They can request audio-visual items or, with an intercom, they can dial control center for additional materials stored there. Dial access will give programming of a limited sort. When we get into the video system next year, we can also dial in and get a video program by means of a small TV monitor. This will also be housed in the control center, but will be distributed throughout the campus. Another area is the center platform pad. It is a general open reference area. Below it will be the periodicals with study carrels grouped around them. On all sides will be book stacks and small study areas. No area for study would hold more than 25 or 30 students. We think this is a good practice; it gets rid of the old long table study areas that have never been particularly conducive to good study. Small areas allow for limited social activity which does take place in the library. There will also be rooms within the library complex where typing can be done and where small group discussions can take place.

Returning once more to site problems, we had to orientate this project architecturally and esthetically to the ground available. There was no feasible way that we could introduce extensive landscaping. So we took the approach that we would run the desert right up to the school. With that in mind, we started developing some study models on how this was going to look. We wanted it to appear uniquely Nevada without seeming to have been transplanted from one of the New England states, or Southern California or somewhere else. From that decision on, the project began to develop a little architectural character. We tried to enhance this architectural character by taking some of the beautiful lava rock already on the site and blending it, in limited quantities, with walls for an esthetic effect. It's a nice rich chocolate brown and we used it to bring contrast to concrete tilt-ups. We are bringing in some small numbers of trees and coast landscaping, but beyond that we will utilize the natural terrain. Our impression is that we have brought together an interesting distribution of materials, colors, lines and textures, unlike anything we have seen elsewhere, which gives an atmosphere of dignity to the entire setting.

THE INTEGRATED CEILING

Mr. Harris Sharp
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These remarks will be largely confined to the development of integrated ceilings. The word "flexibility" came into use by school planners about 20 years ago and caused a tremendous revolution in schoolhouse planning. Flexibility extends to partitions which divide large groups into small groups and those into smaller groups, or even into individual setups, and yet move quickly back into very large teaching groups. Not much, however, was done about the flexibility of the ceiling. People moved partitions around but they disturbed the air conditioning, the heating, and the lighting systems in the process. This result gave birth, about seven years ago, to the concept of an integrated ceiling. The outcome was the evolution of many different kinds of ceilings. One was the SCSD grid-integrated ceiling.

With an integrated ceiling you can have luminous ceilings or all kinds of lighting combinations. But to be a truly integrated ceiling, you need at least four factors. First, it has to contain all the light source for the space that you're utilizing at the time. Second, it must contain acoustical properties, and third, it has to contain outlets for the air conditioning supply and return air, and finally, it has to be completely flexible.

Now, with a completely flexible building having movable partitions within it, the ceiling must be equally adaptable, permitting you to move air conditioning, registers and lights. The ceiling, of course, must be accessible so that these changes can be accomplished. Flexibility entails a great deal more than this. Architects believe that in the years ahead it will be necessary to think more and more about built-in change within our school areas to take care of the various utilities that are involved in many of the teaching aids that are now being developed. In doing this, we have used our ceiling plenum -- that is, the space between the closed ceiling itself and the roof area, as a utility space. Now within this space we can run all of our heating, air conditioning, lighting ducts, and other utilities. They can be moved, and they can be reached very easily if laid out in a truly integrated system. It also offers a big utility space that covers the entire structure, where in the future we can run closed circuit television if it's not already there, along with many other innovations to aid teachers that may not even be in existence today. I mentioned the SCSD ceiling which, unfortunately, has one fault. It is on a five foot module, and it allows for only a rectilinear type of flexibility. In other words, all your rooms are on a rectilinear square basis, whereas a true integrated ceiling would allow you to move partitions to form a space of any shape. Integrated ceilings prove to be a bit more expensive than the old, normal ceilings. The integrated ceiling that you see in the SCSD program runs somewhere around $2.00 per square foot depending on the light source system that you use.

Drawing your attention to the ceiling is just another way of underscoring the need for detailed planning of proposed new facilities. Though the ceiling and the little used space just above it may well be critical to a fully efficient building, experience has proven that its possibilities are all too often overlooked.

PROGRAM PARTICIPANTS' ANSWERS TO GENERAL QUESTIONS ON SOUTHERN NEVADA VOCATIONAL-TECHNICAL CENTER AND RELATED MATTERS

William Blurock
John Boice
Clayton Farnsworth
Kenneth Guinn
James D. MacConnell
Norman Rutgers
Raymond Sturm

QUESTION #1: Does carpet absorb much noise in big rooms of this sort?

MR. BLUROCK: If you're trying to keep sound confined in a space, and keep it from going outside a specified area, then you have to sacrifice one thing for something else. To keep sound from penetrating areas beyond a large room you sometimes are forced to use amplifiers to send sound within the room.

QUESTION #2: Would a hard surface in the center of a large room improve its accoustical qualities?

MR. BLUROCK: I don't think we would want such a surface because at times there may be two, three or four different groups in this large area at one time. So you want to create an atmosphere in which all those groups can work, and not cause interference between groups.

MR. FARNSWORTH: As you pass through an instructional corridor, you'll find seven or eight classes going on and while you can hear these people in discussion when you are directly opposite the entrance to that area, very little sound travels

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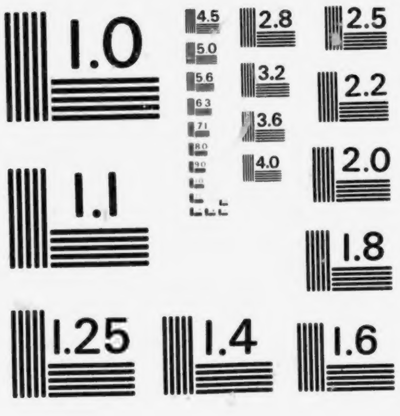
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

down the corridor.

QUESTION #3: Have the open classrooms improved teaching?

MR. FARNSWORTH: I don't think there's much question but what that has been the case. Neither the teachers nor the students can hide away. We have had nearly 1500 people through here this year and everyone is on display every day and I think this brings out the best in teachers and in students.

QUESTION #4: What about the showing of motion picture films and slides in large rooms? Do you have a light problem?

MR. BLUROCK: You just turn the lights off. This is 14 percent glass here. You might get a glare looking directly at it, but it would be minimal. You don't need to have complete darkness to show films.

MR. FARNSWORTH: The only problem we've experienced thus far is with the electrical system which is set up on a master basis. Consequently, where some of these walls have been placed on a temporary basis, we occasionally have an overlapping area where we wish to cut the lights out. We'll remedy this during the summer by putting in some additional switches.

QUESTION #5: Down below where you have your typewriters and other business machines, the electrical system is in the floor. Doesn't this permanently fix this area and reduce its adaptability?

MR. BLUROCK: This was requested and the cost weighed against how long they would be using that kind of arrangement. There was a premium paid for putting that particular area in as it is but we felt it could be justified against other costs. It probably is the only place where anything comes up from the floor and I would not anticipate changing it for some time to come.

QUESTION #6: Why don't you have a public address system built into all areas?

MR. BLUROCK: I might point out that we are gathered in an area that is the future student center -- student offices, counselling rooms, and this sort of thing. It is only temporarily being used as classrooms so it would be to no advantage to build in a complicated PA system here.

QUESTION #7: What are the advantages of locating the plant where you chill and heat your water in a separate building, rather than housing it within one of the existing structures?

MR. FARNSWORTH: Remembering that we are master planning something on an increment program, I think we did pay a premium to put in a central system in the first phase. But it is a decision which will pay off in the expanded program. The central system is now located somewhat outside the present center of our campus, but it will eventually be the center of this entire complex.

MR. BLUROCK: In view of fire regulations, insurance regulations and so on it's probably a little better to have the system in a separate area. You actually pay very little premium to divorce it, and since it will someday be in the center, it's more accessible to expansion. You also don't put in three times the boiler capacity needed now. Rather, you put in a small boiler and later add onto it to match its capacity to the expanding facility.

QUESTION #8: One of the big problems in vocational technical buildings is storage for parts, supplies and equipment. Would you say that you have adequate supply storage space here in your facility?

MR. STURM: No one ever has enough storage space. Our new Educational TV is about to eat up some of our planned storage space which will make a present problem even worse.

QUESTION #9: Do you have a central warehouse with storage space?

MR. STURM: Not on this campus at the present time, but we do have several large central warehouses.

QUESTION #10: Are your toilet facilities and dressing rooms the self-contained or general type?

MR. FARNSWORTH: Some of the locker and shower facilities are self enclosed. Eventually, as we move the physical education facilities away from the building, showers used for those activities will be reserved for the technical building alone.

In the Culinary Arts areas we have showers and dressing rooms off from that facility.

QUESTION #11: Is your automotive area arranged to your satisfaction?

MR. FARNSWORTH: We find that this is very satisfactory up to now. It gives an opportunity for these people to have a locker in there and maintain their uniforms and their coveralls if they want to, permitting them to make a quick change. Afterwards they can move promptly into the other parts of the facility for additional training in the academic area.

QUESTION #12: Are the classroom areas proving successful where there is no divider between them and the nearby shops?

MR. FARNSWORTH: This may produce somewhat of a problem eventually, although this year it has not. Primarily, our instructors go into the classroom and take a group of students for a general lecture. Later, they move directly into the shop area. Perhaps, as we move into the air frame section this may produce somewhat of a problem, but the air frame building will be separate and away from this section, thus permitting an expansion of the automotive area.

QUESTION #13: How many high school people are involved in programs this year?

MR. FARNSWORTH: We started out with about 390 people. Out *of this group there were about 90 adults who were returning for a high school certificate or adults who were paying tuition. This means we had about 285 to 300 students entering here as high school juniors and seniors.*

QUESTION #14: How big a staff, including administration and secretarial, do you have?

MR. FARNSWORTH: I have an assistant principal and two counselors. We have only two secretaries who have been hard pressed to do the necessary correspondence associated with the hundreds of people who have toured the facility this year. There are, in addition, nine academic teachers plus 22 vocational instructors on the staff at the present time.

QUESTION #15: Just how do building or facility innovations come about?

MR. BLUROCK: I might say that the architects came into the picture fairly early. However, the educational specifications were under development by the staff here and with Odell-MacConnell as educational consultants for about a year prior to the start of construction. We tried to work as a team to pull together the philosophy that these people wanted. Opening up spaces so people are on display, so that materials are on display, and so that the function itself is on display.

MR. STURM: We wanted something different, because we have a philosophy here in Clark County that evidently differs from many philosophies in vogue elsewhere. We feel that our youngsters, properly motivated, can act in an adult role as well as every one of us. Another thing is that we wanted flexibility, emphasizing small group instruction and individualized teaching. This is a school that's operated in an adult atmosphere and this is what we were aiming at from the start. The old four walls had to go, they have been obsolete for years, and our experience has served to strengthen that conviction.

MR. FARNSWORTH: I confess to some real doubts when this construction was going forward regarding the eating area. Mainly because it was to be entirely carpeted. I originally had requested that this facility be put into tile because I was concerned about its maintenance. I was overruled and I'm glad now that I was because carpet has been 100 percent effective, and the young people in the dining area have had great pride in it.

QUESTION #16: Have you had to send anyone back to their own school because they did not conform to your rules?

MR. FARNSWORTH: I have sent some back. The State law requires that a student remain in attendance until age 17. Those students who are over 17 and who do not adapt to our program are asked to leave. They are not generally admitted back into any high school. With perhaps a semester break they are given an opportunity to re-apply. At the semester break, I dropped 16 students who were failing in class and not doing *their work. We evaluated each case and if the instructor felt they would not be successful, we screened them out. We also dropped a few rough kids right at the beginning of the year. On the other hand, we have also accepted a few special education students to see how they would work out, particularly in the culinary arts area. Some of these people we had to drop. We made no bones about it to these students. We told them if they wanted to stay, they would have to do the job. We have this stipulation clearly accepted by the School Board and as a consequence we've established what we regard as a prestige school. It's been rather interesting in re-registering some of these youngsters now, with summer coming along, most other kids are talking about getting out of school -- but our youngsters talked about next Fall, "When do we get started, Mr. Farnsworth?", "When does school start again next Fall?" This is the predominant attitude that these people have now and we are thoroughly delighted with it.*

QUESTION #17: What was your reaction from the parent when his youngster was dropped?

MR. FARNSWORTH: Before dropping any student, we had a conference with the parent. We told them what we were attempting to do, explained the situation to them. Some of them had a few tears in their eyes when their youngsters were moved out of here. Despite this, we let them know that that was exactly what we had decided to do and we followed through with it. I don't think there's been any negative response.

QUESTION #18: In your academic subjects, one of the students said they had 45 minutes for each class. Is this required for the entire State of Nevada?

MR. FARNSWORTH: Yes, 45 minutes meets the minimum requirement as set by the State Department of Education. Now, some of these classes this year, we tried on a 45 minute basis for structuring. As it turned out, some of these students spend as much as five hours in Cosmetology, for example. They must also attend three more classes of an hour each. These two together amount to a 7½ or 8 hour day in school to which they also had to add another half hour or more traveling back and forth. We felt this was just too long a day, so we agreed to merely meet the minimum class requirements set by the State Department.

QUESTION #19: What have been your transportation problems?

MR. FARNSWORTH: Parking has given us many problems because we anticipated there would be public transportation to our facility for these youngsters. When it failed to materialize we found ourselves swamped with hundreds of cars for which we had not planned.

QUESTION #20: I'm still wondering about the carpeting. It certainly must have a life expectancy of a given number of years, whatever it might be. What about traffic trails that wear into the carpeting, are you going to have to replace an *entire room? Would a tile type carpeting application be better than your sheet application?*

MR. BLUROCK: I think the life expectancy of the most heavily used parts of this carpeting are probably in the five to ten year range which is not too dissimilar from that for resilient tile. I would only respond this way: by the time we get through with the third phase we will have moved enough walls around so that we probably won't have the trafficways in the same places any more. On a maintenance basis, I think you'll find that your carpeting will pay for itself over a short period of time even though it has to be replaced in some areas. They actually clean this carpet with lacquer cleaner when they get a gum or some such substance stamped into it. So, if it'll stand up under that type of maintenance, it's pretty good material. I think you should assume carpet to require regular maintenance, much as you would painting or varnishing.

QUESTION #21: How about the stairway where you have a turning problem, will carpet show excessive wear at such points?

MR. BLUROCK: Well, there's no question about it -- the stairways will be replaced on some type of cycle. However, we could not comply with the educational philosophy that was built into this building without also carpeting the stairs. I'm sure you are aware that stairway tile is also replaced more often than the same type of tile laid in corridors.

QUESTION #22: What about matching up this carpeting when you have to do repairs or effect replacements?

MR. BLUROCK: Did you ever try to match tile? It doesn't work too well, does it? However, we do have a supply of carpeting on hand that will probably work just about as well as matching tile, which, frankly, always leaves something to be desired.

QUESTION #23: I'd like to pursue that maintenance question a little further in terms of the size of the maintenance force for this building, as well as the daily maintenance program.

MR. FARNSWORTH: At the present time we have two custodians on during the course of the day and four evening custodians. Also in the evening I have two people who are responsible for this building and one person in each of the other areas. Mostly, this is a matter of vacuuming, going through the area about twice a week. We find that this quite adequately takes care of it. The toilet facilities are still our major concern, it still takes more custodial time with toilet areas than any other place in the building. We do have a district team that comes around and does most of the outside maintenance. We have a manpower class in landscaping out here, too, and these people are helping us on the landscaping and generally keeping the facility up on the outside. I would say that the general overall maintenance is much less than in some of the other local schools. I had a junior high school in the city *before coming into this facility, with floor space about 2/3 the area of this one, and yet I had more people busy with maintenance than is true here, which gives you a fair indication of the difference.*

QUESTION #24: A question on educational organization. Is the two-year high school with only junior and senior classes a temporary transition, or will there eventually be sophomore and freshmen classes as well?

MR. STURM: First of all, we will maintain this facility on an 11th and 12th grade basis. There is a possibility that we will move into a post-secondary program. The conception of this school here five years ago was that it would include 11th, 12th, 13th and 14th grades, but because of certain limitations, we have kept it an 11th and 12th grade institution. We are moving into the 13th and 14th grades this coming year. We are not at the present time planning on moving down two grades. However, I personally don't think we're beginning early enough with vocational-technical education. I think the preparation has got to start in the early school years. I am convinced that it's got to go back to simple occupational information first presented in the kindergarten year. With that type of early indoctrination, young people will arrive in high school already aware that the world of work has ample dignity to capture and hold their interests.

QUESTION #25: In your post-secondary offerings, what percent *of time do students spend in the lab and what percent of time in related courses?*

MR. FARNSWORTH: Again, this becomes a varying situation, depending on the class being offered. I would say that in many cases it would probably run about 20 percent in academic work. In some cases the academic/vocational distribution might be about even. For example, as we get into our highway technology program, it would be necessary to bring in quite a bit of drafting, some aspects of mathematics instruction, and so on, which would possibly give those students a daily program top-heavy with academic work. Our basic concern, of course, is not with this distribution per se, but with tailoring vocational programs in the best way to produce the best workers.

QUESTION #26: Discuss the three most important guidelines with which an architect can be furnished by the school district that will enable him to tailor a fully functional vocational-technical facility.

MR. BLUROCK: The physical environment that is expected out of the facility should be portrayed to the architect, as well as how the facility is going to be used. Also, the development of a budget should be worked out with the architect and should have flexibility to allow it to be expanded or contracted. But, most important, it should be agreed that the entire program will be a team effort.

QUESTION #27: When planning a vocational-technical school, how would you distinguish the architect who is purposefully creative from the one who is aimlessly innovative?

MR. RUTGERS: I think the way an architect responds to educational specifications is tremendously important and indicative of his ability to work within the framework of that school district. If he does not communicate well with the Board, you've got a problem immediately. Of course, the educational specifications have to be written in a complete and understandable way. Assuming that the architect responds appropriately to the educational specifications, I think one should study how he handles specific requirements. Does he come up with solutions to these problems, or does he fail to solve them even though appearing to be innovative. In other words, is he innovating and still offering a poor solution? Perhaps he displays a different approach, but the basic problem remains unsolved. To me, innovation means change, and change can take two directions, it can either improve a condition, or it can end up creating a condition that is worse than that posed by the original problem.

QUESTION #28: At present, what is the major advantage of utilizing the systems approach to construction?

MR. BOICE: One of the problems we have here is the distinction between the system, as exemplified by the SCSD system, and the systems approach to the design and construction of facilities. First of all, the systems approach does *a number of things. It forces you to start at the very beginning and delineate exactly what you want to do with the facility. As you put down the things in educational specifications that you want to do in this building, you necessarily have to bring your educational program along as you proceed step-by-step to the finished building.*

The systems approach was designed to improve quality through the building process, to improve performance through that process, by setting down agreed upon performance levels and then making sure that these performance levels are maintained by means of a system of testing and evaluation. The next thing I think is important about the systems approach, and a very critical part of it, is the team approach from the standpoint of integrating all of the building systems into a composite, well functioning whole. This has to do, of course, with the integration of services and the integration of major elements of the building that we work so hard to develop. In utilizing a systems approach you are bringing together those people who have responsibilities in a large number of areas in a team undertaking. This will involve not only the mechanical, electrical, structural, and other engineering professions, in cooperation with the architect, but also the trade unions and the craftsmen that will have to put these things into a finished product.

QUESTION #29: Of those features of your building and instructional complex which represent a unique departure from *traditional practices (i.e., floor covering, student selection, adult learners, or whatever), which would you single out as the one having the greatest educational impact?*

MR. FARNSWORTH: I think it's a combination of many things that resulted in an atmosphere of flexibility, or an awareness on the part of teachers that they could try new things, that they could use new approaches, and that they were not bound by the conventional ways of doing things. Much of this was created by the openness of the facility. The use of floor coverings was important, but I would hesitate to say that it was more important than the other features. I read recently that many times in creating vocational-technical centers, it's important to set them completely apart from the traditional approach to education in order to bring in a new atmosphere and change the tired old image for this type of program. I think this is exactly what we have attempted to do in our vocational center, and we are exceedingly pleased with the result.

QUESTION #30: Describe a way that school districts can insure the use of quality materials in the construction of their vocational-technical facilities which remain within the limits set by their budgets.

MR. GUINN: The key word in answering this question is "pre-planning". By pre-planning I primarily mean settling upon what we are going to do, because the budget that you set later on becomes more or less a fixed thing with little flexibility *in it. Develop the full scope of what you're trying to do and then in some way go through an aggressive program of architectural and educational explanation so that you can develop what you want your architect to do. Then select your architect, remembering that the minute you hire that individual your budget is going to be governed largely by what he does. As an educator you will have to lean on him tremendously to give you quality results in a building.*

QUESTION #31: For just a moment, give full rein to your imagination and forecast for us how you envision the vocational-technical facility of ten years from now will differ from even the most modern one of today.

DR. MAC CONNELL: First, the building no longer will be just to keep the rain and sun out. It's going to be a teaching and a learning tool. As we think of it, we see not only the facility itself, but the site as well. Down in Rio we're doing a project with Mr. Blurock as the architect. We are keeping that site in its natural state with a whole stream running through the school. (We may lose a couple of kids, but we hope they'll be from large families and we won't get criticized too much.) Natural beauty should not be needlessly disturbed. Along with this willingness to incorporate naturally appearing beauty into our physical facilities must come an equal willingness to make adequate provision for inclusion in the school plant of all the scientifically useful innovations and developments that emerge from the research centers of the world.

TEACHING AND EDUCATIONAL MODELS

Mr. Al Russell, Director
Education Division, Lennox Industries
Marshalltown, Iowa

The question has been asked by many educators: What is a company such as Lennox, best known as a manufacturer of heating, ventilation, and air conditioning equipment, doing in the teaching model or educational model business? The simple answer to this is that we have our own vocational-technical education program that we run continually. We employ high school graduates and undertake to teach them how to install and service our equipment. We must also have people who can sell these products. Such personnel very frequently are graduate engineers. In all instances, we are called upon to teach them the proper utilization of our equipment. So it is in this sense that we have an educational program contained within Lennox Industries.

School facilities are also of very great interest to us because the design of the building, the method by which the architect puts the pieces together, both provide the potentialities for the proper use of our equipment. Going hand in hand with our concern for the special nature of educational plants is our increasing need to understand the education process, particularly as it touches the area of vocational-technical training.

Two years ago at a vocational-technical meeting in Palo Alto, Lennox Industries became acquainted with Professor Neil Mitchell of the Harvard Graduate School of Design. Since then *we have worked quite closely with him on a number of different projects. One of these dealt with putting together a teaching program designed around a series of educational models. It was Professor Mitchell's feeling that in many areas of his teaching it was much easier to present a model to demonstrate a principle. This succeeded in getting the student involved in feeling, touching, bending, or somehow using the model. Once involved with it, his interest was aroused and he could then begin to move into the mathematics and the technicalities of just what he was doing. This, of course, is not a new or novel way of teaching. Everyone who has been in the educational field for any period of time has attempted to do this in one way or another. I am discovering in my travels to the various universities that many professors have developed items of this nature themselves in order to meet their own teaching requirements.*

The thing that became very evident to us, however, was that while many teachers or professors did this, there was no central clearing house for these ideas which could lead to the eventual manufacture and general distribution of instructional models. It appeared to Lennox Industries that this was a void which needed to be filled. In looking at this total problem, we felt that here was an area in which our own special skills and experience could be brought to bear. We did not envision either a large or a lucrative market, but rather a place where we could make a modest contribution in our own way toward furthering the educational process.

It soon became apparent that we would have to begin by learning a whole new language and even now we certainly lay no claim to having mastered it. We forced ourselves to look at quite a number of different ways of doing things. Different from old familiar ways, yet ways which were basically more instructive. We found that some of the proposed models were quite simple and could easily be made out of plastic, wood, or rubber. While not "kidproof", most of them could be classified as non-breakable with ordinary classroom use. Model durability is absolutely necessary because the basic idea is to encourage kids to work with them.

Early in our progress we discovered that this could be quite a sophisticated field. Tolerance, for example, often had to be held to 2/10,000ths in order to demonstrate an important concept accurately. At present, we have worked out a basic group of demonstration models. As might be expected of an engineering firm, we began with structural models. This group covers beams, columns, frames, principles of stress and strain at a given point, and various models depicting the distribution of weights, stresses and strains. The second basic group of models illustrates a more qualitative analysis of these principles with concern centering on more accurate measurements. Other models are designed to give insight into the strength of special materials and some related ideas essential to the full understanding of basic structural problems.

Our search for dynamic demonstrations has, of course, taken us to many schools other than Harvard and we have found *that a large number of educators have developed extremely useful models in the area of mechanics. These are models which likewise deal with basic principles. In air conditioning or heating, for instance, there are models to demonstrate convection and chimney effects, as well as principles of radiation. These are all fundamental principles that sometimes are exceedingly difficult for the student to grasp in any other way. A good many of these models in the mechanical field are still either on our drawing boards or remain in the thinking stage. However, by the end of this year there will be quite an assortment of things available to the general educational field.*

We have developed a few parameters in looking at these models as they have been made available to us by educators. Frequently production costs turn out to be prohibitive in the light of their probable use. Typically, we take the ideas one at a time, cautiously feeling our way along. We look toward having a wide range of models which will prove economically to be in the ball park. We also hope that they will have great durability permitting their use over and over again for a number of different classes. As a general rule of thumb, we would hope that at no time would any of the models be valued at over $100. Most of them would be considerably less costly than that.

We've found in Canada that many of these models are of interest to them in their mechanical drawing classes where they are looking at perspectives. Most can be placed in full view *in front of the class while the instructor walks around the room continuing his lecture. The visual effect remains before the students throughout the discussion. This, perhaps, is one step beyond other types of visual or audio aids. Visual communication, as you all know, is typically superior to audio alone. When the two are tied together and coupled with student involvement, then one has an ideal teaching and learning situation.*

In closing these remarks, let me say that Lennox Industries is excited about its new undertaking in the world of education. But it should be emphasized that we must still depend to a large extent upon men in the classroom to furnish us with suggestions for teaching models. Ones that will not only command and hold students' attention, but at the same time bring home to them concepts that might otherwise elude them. Even if our success is merely that of significantly shortening the total learning process, we will feel fulfilled. With your expertise in the fields of instruction and learning and ours in engineering talent, we form a team that can make a truly noteworthy contribution to the cause of education.

THERMAL ENVIRONMENTS

Mr. Norman Rutgers
Director of Environmental Systems
Lennox Industries
Marshalltown, Iowa

I'd like to discuss just what we mean by good thermal environment, cut it apart and look at it from various angles. I think we have all attempted to force coordination of various facility components, various elements, into a school and as a result we've ended up with a final product that while it may have been reasonably good, we know it could have been a great deal better. Basically a good thermal environment for vocational-technical schools is very similar to the type of thermal environment we would like to have in any academic situation. There are, however, some specific areas where additional attention to thermal environment must be made.

Each new school presents its own special problems. The educational vacuum for high school students who could not, or did not choose, to go to college was very apparent. There is no reason in the world to believe that every high school graduate should go on to college; but we should give him the opportunity to continue his education in specific areas so he can make a greater contribution to the community and to himself. Also, we should look more toward the adult who wishes to increase his skills and upgrade himself. The vocational efforts in almost every community are directed not only to the 11th, 12th, 13th, and 14th grades, but also to interested adults of the community who wish to increase their own skills and abilities. There is a vocational technical facility in St. Paul, Minnesota, for example, which actually has 6000 students ranging from the ages of 19 to 60 years, demonstrating that this does meet a very definite need.

The United States will show an increase in students in the next few years from about 5 and 3/4 million to over 14 million. But we will deal effectively with this tidal wave of students only by providing the type of facilities that are required for their varying needs. To give you an idea of one recent trend in this country, in 1944, 66 million dollars was spent on vocational education. In the next twenty-year period, three hundred and thirty-three million dollars was spent for vocational-technical education. In 1965 it jumped to 620 million; In 1966 it was 730 million; and in 1967 the figure rose to 815 million dollars! If we take the 1966 figures and wonder where this money came from, out of the total of 730 million dollars, 215 million came from federal funds. The remaining 515 million came from state and local funds, which shows rather clearly that this is not a totally federally sponsored program. The federal money is normally met by matching funds or even by more than matching funds at which point it becomes very much a local problem with relatively modest federal support.

Special needs require early planning and I think others have touched on the necessity of getting into a planning program at a very early date. The Las Vegas School District had been planning for a number of years before they started their first vocational-technical facility. Preliminary planning should involve not only educators, but representatives of local industry, the selected architect, trade unions, and local business and professional clubs. It's amazing how much you can grease the ways in eliminating later conflicts with unions, for example, if you include them in early plans. If people understand what the purpose of the program is on a prior basis, the thing moves along pretty smoothly. Too many schools have been planned and built in a hurry. Planning in a hurry will provide a very expensive type of facility and it will never quite fulfill its educational needs.

The architect's role in designing the modern school is extremely important. My number one suggestion to any school board or any administrator would be to select the most progressive, the most up-to-date architect that can be found. Find the architect that is aware of the latest improvements and advancements in construction; an architect who is not afraid of a little innovation, provided, of course, that innovation has a purpose. If we continue to plan and build new schools based only on our past experience, we're merely going to repeat our former mistakes. If we're going to make mistakes, let's make original ones.

Without question the educational specifications become tremendously important. Without them, I don't think a good planning job can even be started. It won't cost the district, *in the long run, one bit more to hire a top-notch architect than it will to hire a poor architect. (I'm making the assumption there are "poor architects.") In fact, the poor architect can frequently cost the district considerably more than the full fees of a truly superior one.*

The term "learning environment" includes many important interrelated factors. One of the most critical, but the least understood, is that of thermal environment. Good thermal environment will provide an atmosphere in which the student is unaware of any physical discomforts. He is neither too warm, nor too cold. He doesn't have too much air moving over him, nor is he sitting in a stagnant pool of his own body conditions. It includes a lot more than just heating alone. Up until a few years ago, the only relationship to thermal environment was the question, "Do we have a heating system?" When we finish examining this question we will find that the heating system, while it is important, is certainly not the major factor contributing to a good thermal environment. There are other elements in every school situation that make heating a rather minimal consideration.

Let's take a look at all of the ingredients which make up a good thermal environment. We'll cover these one by one. Constant air circulation in any occupied area is very important. If you stop the air circulation, the air becomes stale; it grows stagnant and stuffy, and odors will collect. Just walk into a school that's approximately 15 to 20 years old that does not have good air circulation. Remember, it's that familiar old school with the gymnasium in the center, the principal's office on the right-hand side as you come in, and the classrooms fanning out around the gym. Open the front door and take a good deep breath. You can smell the sweat socks that have been in the lockers for the last ten years. That odor just seems to permeate the entire school; it hangs there and stays there. To repeat, air must be circulated. You have to pick up the odors, move them out, and bring in fresh air. If you do not have constant air circulation, the air will stratify. In other words, warm air will move up, collect and hang, the cold air will then drop down. Between the ceiling and the floor there can be as much as a 12 degree temperature difference. A student may be standing in a pool of cool air while his head is bathed in a considerably different temperature area, the combination of which can be most disconcerting, and certainly it does not contribute to a good learning environment.

If there is a lot of glass area, and many of these schools have been built this way, we very likely do not have good air circulation. We find that air will collect along the cold glass surface on a cold day of 25 or 30 degrees and will soon start cascading down the glass surface. As that air moves down the glass surface, it will pick up velocity; sometimes as high as 80 to 100 feet per minute. It will move across the floor, chilling feet as it does. In order to stop this cold movement we find that a vertical column of air should be introduced at the glass area. This will eliminate, or, to a large degree, minimize the problem.

In good air circulation, air is constantly mixed, but ideally on a gentle basis. There are some agreed upon requirements of air velocities in any space. About 50 feet per minute comes close to the acceptable maximum. If you get much below 15 feet per minute, air starts to stagnate. About 25 to 30 feet per minute would represent a reasonably good environment from an air circulation standpoint.

Air in academic spaces should be changed four to five times per hour. But now let's look at a vocational-technical facility. We have some areas in a vocational-technical facility which will require considerably higher frequency of air changes. When you get into your laboratories, you may want to exhaust virtually all of the air you're introducing into the space. If it's hot outside, you're bringing in higher temperature air. You have to cool it down to maintain a comfort level, demanding a greater capacity. The major point here is that you must consider the difference. In a welding shop, or an auto body shop there is an exhaust problem. You have to replace that air, so you have to have an air makeup provision introduced into the mechanical system.

Fresh, outside air needs to be filtered and treated before it is brought into the teaching space. We can clean air, of course; a problem that is linked very closely with the problem of air pollution that is becoming the number one topic in many communities. For a while we thought that California, and particularly Los Angeles, had a corner on air pollution. We find now by direct comparison that Los Angeles is not nearly as bad as parts of New York on certain days and unless we develop methods of filtering and cleaning air, we may merely be bringing in an outside problem and creating a new problem inside the classroom space which is equally as bad as it was before it got into the school.

Electronic air cleaning is moving ahead. We're seeing more and more of it being used. It's not cheap, but it is coming down in cost. Using charcoal filters proves an effective way of eliminating odors. These are mechanical methods featuring special devices which can be incorporated into the mechanical system. In older systems, a number of years back, we used to simply open windows for ventilation. This is no longer a sensible solution. Air conditioning virtually allows you to compact a building and by compacting you can save construction costs so you get a trade-off that makes real sense. When you did open windows in those old schools, of course, it was a direct invitation for all the airborne dust and dirt to come right in with the fresh, outside air. In newer school design, we find far fewer windows. If you noticed the Clark County vocational-technical school, there was very little glass. Glass was merely a vision strip which may lead some of you to think of me as being "anti-glass." I'm not at all anti-glass, but I hope to point out to you, if you use great expanses of glass, what you will have to do to counteract the negative thermal effect that that glass will cause. There are areas in between total glass and no glass at all that strike a more practical balance.

One thing about fresh air is that you must control it. This brings us to the subject of air temperature. The human body does not function too well at extreme air temperatures. Circulation is not the only requirement with which we must be concerned. Air really should not vary much more than a plus or minus 1 1/2 degrees from the control center. In some areas you will find a two degree plus or minus variation. In such cases, the body will begin to react to this much change and when it senses a change, it immediately sets up a process to offset it. The physiological relationships of man to his environment provide an extremely interesting study. This is one of the areas in which we are attempting to work with the Graduate School of Design at Harvard University. Body temperature adjustments take energy; it distracts a person from his studies and lowers his efficiency. The human body is also sensitive to the rate of temperature change. In other words, if you change the temperature in a room gradually, the body will adapt to it without too much straining, but if you bounce temperatures back and forth too drastically the body will react strongly to it.

Recent research also suggests that if 72 degrees is an optimum temperature at 11 o'clock, it is not necessarily true that 72 degrees is the optimum temperature for the same group of students at 2 o'clock. We think we might be on the verge of programming temperatures to arrive at ideal temperatures for the time of day following, say, a lunch period, and particularly programming temperatures in relationship to the academic courses or the studies that are going on. Very little is known about this at the moment, but since we are living in a computerized age, there is no reason in the world why we can't program for temperature changes as long as we know at what levels we should gauge it.

We should refer some to sound. We have, in the mechanical area, tried to reduce sound levels. On one occasion, we were able to get the mechanical sound level down to the point where the ballast in the fluorescent tubes was perceived as noisy and began to bother the people within the building. This was too much success. So now you reverse that trend and you come back up to a sound level which is compatible to the surroundings. A dead, quiet sound is actually most irritating. You need to have a level of sound but you have to plot the frequency of it against the pressure level of the sound.

Interestingly enough, heat is never added to the body. We never, even when we're in a heating situation, apply heat to the body. What we do, however, is regulate the heat loss from the body. Now, this is understandable when you think in terms of your body temperature being 98.6 degrees. Therefore, if I'm adding heat to the body, I've got to add heat at a higher temperature. My room, then, would have to be warmed to a level above 98 degrees before I could transfer heat from the room to the body. So when I maintain a 75 degree temperature, I am merely controlling the rate at which the body heat is being lost and when I allow the room temperature to drop down to 60 degrees, I begin to lose heat from the *body at a faster rate, making me uncomfortable. I start to shiver simply because my body's physical processes are attempting to offset this increased heat loss. We heat the walls and the furniture, and all of the appointments. You're bringing them up to a temperature level and you're controlling the rate of heat loss from the body at the same time. Mechanical systems control the rate of heat loss merely by varying the ambient temperature surrounding the body. The closer the air temperature is to 98.6 degrees, the more difficult it becomes for the body to lose heat. This is apparent in the summertime. You feel stuffy. Your room starts to build up without air conditioning and your body cannot lose its heat, therefore your internal temperatures start to rise, just fractions of a degree, perhaps, but even so an extremely uncomfortable situation occurs.*

Earlier we touched on air cleanliness and pollution. This is becoming more and more a major factor in mechanical design. Dirt and lint from clothes are all about us and the city air contains many contaminants. These contaminants are constantly being brought into the school itself. All such foreign matter should be removed from the air that the student breathes.

Today there is an additional area provided for in the plans of new schools designed to offer atomic fallout protection. This is a core area in which the students will congregate during a critical period. Of course, when you start to bring more students into a smaller area, you imme-

diately change your thermal requirements. This requires shifting one's capacity from a total area into a confined area so that we increase the air volume to maintain the necessary minimum per student. Under a critical condition we extract the airborne radioactive particles from the air being brought in, as well as cool the air so that the temperature rise is controlled within the space. This can be accomplished without great additional cost, and has the added advantage in that it combines a school protection area with an essential community function. Certainly a lot more research must be done in this area and more people in the mechanical field should gain an interest in this research. Our basic tenet, however, still remains: air cannot be cleaned unless it is moved and circulated.

Let's look now at one of the biggest culprits in maintaining a level of comfort and that is the problem of heat gains. Our vocational technical facilities are being designed and used for year-round operation. Therefore, it is almost mandatory that we take a second look at the mechanical systems that go into a vocational technical facility. Let's pass over for now the summer months. We can all agree that in the summertime, in almost every American community, there will be temperature rises which require some form of mechanical treatment of the air to insure physical comfort. But in the winter, there are some very interesting heat gains that occur in a building where the outside temperature drops to zero.

Suppose there is a lot of glass area in a building.

Depending on the exposure, glass can add in excess of 240 b.t.u.'s of heat per square foot of glass. Relate this to the fact that in one ton of cooling there are 12,000 b.t.u.'s. Some simple arithmetic shows that a relatively small amount of glass area under some conditions of exposure can soon require a full ton of air conditioning to offset. Heat can build ***up in a hurry.***

We have another problem that's related to this. Our lighting levels are going up sharply. Ten years ago our schools were designed to flood areas with about 70 foot candles. Today, 70 foot candles is at the lower level. We now recommend up to 100 foot candles and, if we would listen to the people in the lighting research, the watts per square foot would increase still more. Let me elaborate on this last reference. Today, for each square foot of building we typically have approximately 4 watts of electrical power. This is directly related to the heat input into a space since every watt of electrical power consumed will place 3.4 b.t.u.'s of heat into the area. We started out with 4 watts per square foot and we're now talking about lighting intensities going up to 100 foot candles from the old base of 70. In some instances, as much as 250 to 400 foot candles in lighting intensity is being recommended. While I am not a lighting expert, I can tell you that if we go from 4 watts to 6 watts per square foot, you're going to add a whale of a lot of heat to an area which will have to be countered with additional cooling capacity.

Take a conventional 900 square foot space at 4 watts per square foot, we have 3600 watts total. This would convert to about 12,000 b.t.u.'s, so we'll need a ton of cooling put in this room just to offset the heat from the lights. I'm merely pointing out what some of our problems might be. The maximum solar gain, plus the lights, plus the students themselves in a 900 square foot classroom can produce up to 60,000 b.t.u.'s. Now in those parts of the country where we occasionally have temperatures down to 25 degrees below zero, we would not need any heat in the classroom even on a zero degree day. We have enough heat from the lights, from the sun (if the sun is shining) and from the students to maintain an adequate balance. If you move up the outside temperature level to 10, 15, or 20 degrees above zero you are into a cooling, rather than a heating situation.

It's also an important problem to bring a building up to temperature in the morning so that it is comfortable when you go in. It's also a problem to maintain the building at night. But once you occupy the building and school is in session, the night heating situation may well disappear and be replaced almost instantly by a cooling one.

We'll consider a little about zoning before we get into the twilight period where we need some heating around the perimeter but at the same time some cooling on the inside. These are problems of control. The ingredients for a good thermal environmental system, then, are a supply of fresh air, with the air contaminants removed. If the air is at an abnormally low or high temperature, it has to be treated -- either heated or cooled. We have to have proper humidification, and finally we should constantly circulate this air.

Let's look for a time at why schools should be air conditioned. Rather than insist that schools be air conditioned, perhaps we should ask the question, "Why should schools be air conditioned?" This is what the voter is going to ask. And he is not going to take a statement and believe it. He's going to question closely this expense. First, most vocational technical schools are being planned for 12 months. If you're going to use that school during the summer period, air conditioning is certainly important. If the requirements that we have set forth have any validity at all, then I think that we should recall that even in the heating periods, air conditioning or cooling in some manner may be important.

We do have a communication problem and that centers on the reaction of the public to the term "air conditioning" and I wish we could find another term. There is a built-in resistance on the part of a good many people, who perhaps do not have air conditioning in their homes, because they feel that it is a terribly extravagant frill. At any rate, we have a public relations problem. As educators, as architects, as industrial people, we must school the public on the necessity of establishing a good thermal environment.

Let's look briefly at the various methods of air conditioning that can be accomplished in the school building and also examine their cost.

The system similar to the SCSD solution came out at about $750 a ton. The mechanical costs for SCSD have been maintained at virtually the same level as they were 4 years ago when they were figured. The gas-fired, multi-zone, on-the-roof type has some obvious advantages. You put the system on the roof and generally speaking you do not lose any building space. You still need some space, of course, for incinerators, water heating, and so on. Reference here is only to the heating and cooling equipment. We could take the same equipment and put it inside a building which will require about 300 square feet for every 60 tons of cooling capacity. If we use a hot water system, and use a direct expansion coil, the price goes up some, as do also the spatial requirements. Space requirements do increase if you go to a hot water and chilled water system with a four-pipe distribution system.

What is clear to the environmental specialist is that the school must be capable of changing thermally just as much as the physical spaces must lend themselves to change. A school without flexibility is obsolete the first day that students walk in the door. The traditional school has been a series of inflexible boxes which, among other things, contribute to some thermal difficulties.

Now let's consider the design of air conditioning for schools. Teaching methods evidently become obsolete faster than General Motors cars. We now need, for instance, the ability with audio-visual to darken the room and to lighten it. In the past when the budgets were drawn and air conditioning was merely added to the conventional design of the school, the School Board went carefully over the bid. The first thing that was cut out of the job was air conditioning. Nobody really thought about it as being a design problem. Frequently, air conditioning can become a design tool and this is the way we are beginning to use it. As such, the basic space requirements can be met at less cost. Let's see just what kind of savings we can get from proper design. Basically, if you can cut down on the perimeter construction of a school you're going to save money. In Atlanta, Georgia, the vocational technical school reduced its exterior walls by 2,593 lineal feet. By reducing that amount of lineal dimension, they saved more than a quarter of a million dollars on construction, or more than enough to cover air conditioning.

Some types of insulation can also reduce cooling requirements by one ton for every six classrooms or about $750. But more important than that, for every ton reduced, you reduce the operating cost. That continues for the entire life of the building. Again, insulation has a place. You can, of course, over-insulate. You have to trade off now the added cost of insulation against the reduction in cooling. If we can reduce the number of window frames and their installation, we can save for a normal-sized window about $50 to $60. Along with this, glass breakage can be a major problem in many of your more metropolitan areas and, glass must be covered with shades or drapes if you're going to employ audio-visual teaching. Again, I'm not against glass -- if you *want to use it, fine, but bear in mind that glass effects your thermo-environmental system, and other factors, too.*

Entrances that are faced away from the prevailing winds reduce the heat loss. But windows that are protected by shade trees will reduce solar gain. Also, if you can face windows to the north or to the east you will reduce the amount of solar gain that comes in through them. If the building has a narrow dimension and you can use that dimension on an east to west axis, you are better off than putting the long dimension facing the west where you get a greater sun gain.

We think a good thermal environment can reduce the number of doors. The door is a kind of traditional thing. We've always had them, but we need not always retain them. A door is not necessarily a means of entering. Frequently a door is a means of keeping people out. I think in any part of our educational facility we want to invite as many people into the facility as we possibly can.

In a good thermal environment we can also achieve savings if we go overhead, some pipe tunneling, and trenching. We can reduce equipment rooms, too, if this seems to be desirable for the school. In an equipment room that's reduced to $15 per square foot, for instance, you can save $7,500 to $12,000 on non-teaching space. These are things to at least consider. A good thermal environment should have outside air introduced into the building under controlled conditions. Now, the real value here, in addition to freshening the air, is that for temperatures down to 20 *to 30 degrees, I can use that air that's outside at that temperature and cool* ***with it*** *rather than start my compressors and use electrical power.*

What are the benefits of a good thermal environment? Well, with a good thermal environment, students learn more. This, I think, has been fairly well substantiated in reports available. Figures have shown that 23% of the elementary students improved their grades in a proper thermal environment compared to kids in an identical space adjacent to them. We are now undertaking a full year study on this kind of comparison. What about the thermal effect on teachers? I think here is one of the real indirect benefits because the recruitment of teachers can be a very difficult problem today. It has become very competitive and I'll bet that if you have an air conditioned school you will have more applicants for your good jobs than if you are trying to bring them into a non-air conditioned facility. Good thermal environment not only attracts good teachers, but allows the teacher to perform at a higher level of efficiency. It reduces his or her fatigue. It does all of the things for the teacher that we have been talking about for the student, and yet, it's just as important for teachers as it is for students.

A good thermal environmental system will allow windows to be closed and the air filtered, which will reduce cleaning within the building itself. This is quite significant. The glass reduction that air conditioning will allow will also reduce vandalism and glass breakage. We have found that for every dollar that you can save on maintenance and operational costs per year, you can afford to put about $8.00 more into your initial structure.

Many specifications are requiring maintenance and service contracts to be offered by the equipment manufacturers. SCSD required this. It is changing the structure of our company because we are going into the service and maintenance business on a national scale. Here is what it does. When you as the educator or as the architect specify that the manufacturer who is going to supply the equipment shall be responsible for that equipment for a minimum period of five years, with an option for an additional 15 years, the manufacturer who is putting the component parts into that product is going to look pretty carefully at each piece and each part because it's his baby should it prove faulty. He must pay for the replacement components and this insures a higher level of maintenance at a lower overall cost. Our maintenance costs are now running between 3 and 4 percent per year. It can go down from that point. That 3 and 4 percent figure is computed on the installed cost of the mechanical system. A service contract can be tailored to fit the local maintenance program. In other words, if a school district has extensive maintenance personnel, we can write a service contract merely to come in four times a year and do a total inspection and an on-site adjustment. The rest of the year the local district maintains the product. If you have a small school with no maintenance personnel, then you can buy a total maintenance program. I think you are going to find more and more emphasis on maintenance in the immediate future. Air conditioning is not a frill today, nor is it a luxury; rather, it has become just as important as the bricks, the blocks, the roof, and even the teachers. An air conditioned school will not give you a good educational program, but a good educational program will function better in a good thermal environment which, of course, would include air conditioning. With air conditioning, you'll also find other groups utilizing the facility more for evening meetings, and for important gatherings. The school library can do double duty in a small community by serving as a community library, as well. Round-the-clock utilization reflects back again to a sound thermal environment. With a flexible, adaptable thermal environment in your school you have laid the groundwork for an educational facility prepared to serve you and your community at an optimum level of efficiency.

APPENDICES

APPENDIX A

CONFERENCE CONSULTANTS AND PLANNERS

Dr. J. Clark Davis
Professor of School Administration
University of Nevada

During his career in the field of education, Dr. Davis has served as a classroom teacher, principal, superintendent, and college professor. At the present time, he is directing the Research Coordinating Unit for the State of Nevada in addition to his regular faculty duties at the University of Nevada.

Dr. Davis has acted in a consultative capacity for many of the school districts in Nevada, and has assisted in conducting numerous surveys, studies, and planning conferences, all relating to programs and facilities. In addition, he has served as an educational consultant to various other states and to private foundations.

Dr. Davis has authored various articles for professional journals and has published many monographs relating to the area of school administration.

Dr. Stephen Knezevich
Associate Secretary
American Association of School Administrators

Dr. Knezevich has had many years of experience in the field of education, having served as a teacher, principal, superintendent, and college professor. He has been a Professor of Education at Tulsa University, Iowa University, Florida State University, and a Visiting Professor at several other universities, including the University of Colorado. He has written four textbooks in the field of school administration, and has authored numerous articles for professional journals.

At the present time, Dr. Knezevich is Associate Secretary of the American Association of School Administrators. He also acted as Chairman of the writing committee which was responsible for developing the GUIDE FOR PLANNING SCHOOL PLANTS for the National Council of Schoolhouse Construction.

Burnell Larson
Superintendent of Public Instruction
State Department of Education
Carson City, Nevada

Prior to his appointment to the position of Superintendent of Public Instruction for the State of Nevada, Mr. Burnell Larson had served as a teacher and administrator in the school systems of Nevada. He was, for several years, the Superintendent of one of the largest geographical school districts in the nation, and in this position was responsible for the planning of many school facilities.

Mr. Larson is a member of the Council of Chief State School Officers and is a member of the Board of Directors of the Nevada Education Association. He has served as consultant to educational conferences, and has been instrumental in the development of educational programs.

John R. Boice
Associate Director, School Planning Laboratory
Stanford University

Mr. Boice has been a member of the School Planning Laboratory staff since 1949. He has taken part in or directed over thirty-five studies and surveys throughout the western United States, Alaska and Hawaii. These studies were concerned with all phases of the educational population studies, master planning, educational specifications, building plan evaluation, finance, administrative organization and related areas. He was responsible for the administrative intern program in the School of Education, which involved directing field evaluation studies and conducting weekly seminars for administrative interns.

As Associate Director of the Western Regional Center, EFL, he is responsible for the directing of twenty-two school planning projects, elementary through university levels. In planning he has worked extensively with school boards, superintendents, architects, engineers, school planners and the general public.

Raymond L. Sturm
Director, Vocational and Adult Education
Clark County School District
Las Vegas, Nevada

Mr. Sturm has enjoyed a variety of experiences in the general area of vocational education. He has served as head of the

Trades and Industries Division of the Central Utah Technical Institue, and as Officer in Charge of Vocational Technical Training for the United States Naval Station in Memphis, Tennessee. In addition to his experience in the field of vocational education, Mr. Sturm has also acquired valuable experience in industry, including experience with Douglas Aviation Company. Vultee Aircraft Corporation, and Ben Hur Products Company.

Mr. Sturm is at the present time Director of Vocational and Adult Education for the Clark County School District.

Clayton E. Farnsworth
Principal, Southern Nevada Vocational-
Technical Center
Clark County School District
Las Vegas, Nevada

Mr. Clayton Farnsworth has been a teacher and administrator in southern Nevada schools since 1950. He assumed his present position in March, 1965, and since that time has been actively involved in both the actual operation of the Voc-Tech Center and the planning for the planned expansion of it.

In addition to his regular duties related to the Center, Mr. Farnsworth has served as consultant to the Clinton (Iowa) Job Corps, the Florida State Department of Education, and the Stanford Facility Conference.

William E. Blurock
Consulting Architect
1550 Bayside Drive
Corona Del Mar, California

Mr. Blurock is at the present time Principal Architectural Consultant for the firm of William Blurock and Associates, which has completed hundreds of projects in the educational and institutional fields.

Mr. Blurock served as consultant to the Educational Facilities Laboratory, the Stanford University School Planning Laboratory, the Community College Planning Center, and has actively participated in the School Construction Systems Development Project. He has been a member, for the past six years, of the California Council, American Institute of Architects Committee on Schools and Colleges.

Norman L. Rutgers
Assistant to the President
Director of Environmental Systems
Lennox Industries, Inc.
Marshalltown, Iowa

Mr. Rutgers is, and has been, actively involved in the development of environmental systems for many different types of facilities, including vocational-technical facilities. He is a member of the American Society of Heating, Refrigeration and Air Conditioning Engineers, a member of the School Facilities Council, and for two years has been a guest lecturer at the Harvard Graduate School of Design.

Kenny C. Guinn
Managing Associate, Davis-MacConnell-Ralston
230 East 17th Street
Costa Mesa, California

Mr. Guinn's professional experience in the area of school plant planning and construction is a unique one. He has served as School Planning Coordinator for the Clark County School District, Las Vegas, Nevada -- one of the fastest growing districts in the United States. His primary responsibility was for the educational planning and coordination of various projects. Mr. Guinn was directly involved in the opening of twenty-four different facilities to house students; more specifically, seventeen elementary schools, four junior high schools, two high schools, one vocational-technical high school, one administrative complex, and one warehousing and maintenance complex in the short period of two years.

Mr. Guinn has experience as a teacher and administrator on various levels in the field of education.

Harris P. Sharp
Zick and Sharp, Architecture-Engineering Office
Las Vegas, Nevada

Mr. Sharp has been actively engaged in the field of architecture in Nevada since 1947. Prior to that time he practiced architecture in New Mexico, where he was instrumental in the planning and designing of the Los Alamos Atomic Community.

At the present time Mr. Sharp is Chairman, Nevada State Board of Architectural Examiners; Member, Western Conference of Architectural Registration Boards; President A.I.A., Las

Vegas Chapter; and his firm is on the select list of architects for the Clark County School District.

Stanley O. Bokelman
Acting Director
Department of School Facilities
Clark County School District

Mr. Bokelman has occupied many positions in the general area of facility construction, including those of director of school construction, estimator, construction supervisor, architectural draftsman, and production manager.

In his present capacity, Mr. Bokelman works closely with all of the facility construction in the Clark County School District, where some 32 million dollars in construction has been completed to date.

Dr. Thomas T. Tucker
Chairman, Department of School Administration
University of Nevada
Reno, Nevada

In addition to his regular duties at the University of Nevada, Dr. Tucker has conducted many comprehensive school surveys of Nevada educational systems. The surveys conducted have related to: General Control and Administration; Instructional Personnel; Educational Program of the School; School Enrollment Data; Planning for School Facilities; Fiscal Capabilities; and Essential Services.

Dr. Tucker has also served as consultant to the Governor's Council on Education, the County Superintendent's Association, and as Executive Secretary to the Nevada School Trustee's Association.

Dr. James D. MacConnell
Director, School Planning Laboratory
Stanford University

As a result of his work with the School Planning Laboratory, and because of the work of Odell-MacConnell Associates, Dr. MacConnell has gained a wide reputation in the field of both school planning and school construction. He is widely known for his efforts aimed at integrating modern concepts of school construction with principles of child development, curriculum, and methods of instruction.

Dr. MacConnell has contributed articles on both school administration and architecture to many professional journals, and has written or edited several publications of the School Planning Laboratory. He is the author of PLANNING FOR SCHOOL BUILDINGS (Prentice-Hall, 1957). Additionally, Dr. MacConnell has served as an educational consultant to many of the major school systems of the United States, and in a similar capacity has worked with the educational systems of several foreign nations.

Dr. Robert McQueen
Professor, Department of Psychology
University of Nevada

Dr. McQueen has been with the University of Nevada since 1955, and during that time has acted either in an advisory or consultative capacity for many state agencies and local school districts, including the State Department of Education, the Nevada State Hospital, and the Ormsby County School District. He has written many articles pertaining to his major field, and has worked closely with the Research Coordinating Unit for the State of Nevada.

Dr. McQueen holds membership in the American Psychological Association, Nevada Psychologial Association, Phi Delta Kappa, Society of Sigma XI, and Phi Kappa Phi. He is Director of the Honors Program at the University of Nevada, Chairman of the Scholarships and Prizes Board, and a member of the Governor's Committee of the Fulbright Selection Program.

Willard J. Beitz
Principal, Ed. W. Clark High School
Clark County School District
Las Vegas, Nevada

Mr. Beitz was appointed to his present position while he was Principal of Western High School in Las Vegas, and while Clark High School was, in reality, still on the drawing boards. As a result, Mr. Beitz was very actively involved in the total planning ---- construction, facilities, and program ---- for the Ed. W. Clark High School.

While at both Western and Clark High Schools, Mr. Beitz has been instrumental in the development of research programs relating to innovative practices. He has reported on both the practices and the research to numerous national conferences, including those of the American Association of School Administrators and the National Association of Secondary-School Principals.

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Mr. Jesser has been associated with the Western States Small Schools Project for Nevada since its inception in 1962. Prior to that time he was a teacher and an administrator in the public schools of Nebraska, Colorado and Guam. His work with the WSSSP has involved Mr. Jesser in the planning of both programs and facilities for the smaller schools of the state and the region.

Mr. Jesser is a member of the Executive Council of the Department of Rural Education, and has served as an educational consultant for schools in Oregon, Idaho, and the schools in the five-state region served by the WSSSP. He has authored many articles and pamphlets having to do with small school improvement, and has presented papers to national conferences such as the Department of Rural Education and the National Education Association.

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APPENDIX B

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